

**Interdisciplinary Documentation of Health Care in the Electronic Health
Record (EHR): Exploring Information Flow and Overlap**

PhD Dissertation

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*Series of dissertations submitted to the
Faculty of Medicine, University of Oslo
No. 1868*

ISBN 978-82-8264-480-8

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Cover: Hanne Baadsgaard Utigard.
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ACKNOWLEDGEMENTS AND FUNDING

Dedicated to the late professor dr. med. Tarjei Rygnestad - friend and tutor

This work has been funded by: Ulleval University Hospital, Norway (now a part of Oslo University Hospital), The Norwegian Nurses Organization (NNO) and The Norway-America Association.

My deepest thanks to all my supervisors that carry a sense of who they were in the drama and to Professor Anne Moen whose maddening attention to detail drove me to finally learn to punctuate prose. My deepest thanks to Professor Leiv Sandvik whose selfless time and care were sometimes all that kept me going writing up this dissertation. Thank you for believing in me.

Thank you for the challenging debates and the shared frustrations to all my colleagues and friends at the former centre of Nursing Research in Ulleval University Hospital. Special thanks to Nina Aarhus Smedby, Glendys Hamilton and Karen Bjøro. Without you Karen, this work would never been initiated or funded. Special thanks go to my supervisor Leslie A. Lenert, MD, MS. You opened many doors for me in search for relevant data in the EHR at the Veteran Affairs Hospital in San Diego, USA. Your kindness and hospitality will not be forgotten.

Thank you, Ingrid, Eli, Tone Maja and Carl Joachim for your friendship, support and language guidance. And last, but not least, thank you to Daniel, Magnus, Nora and Gabriel for being the light and joy in my life.

*Ring the bells that still can ring,
forget your perfect offering.
There is a crack in everything,
that's how the light gets in.
(Leonard Cohen)*

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1.0 INTRODUCTION

This dissertation explores the interdisciplinary documentation and collaboration processes between nurses and physicians reflected in the patient's accumulated Electronic Health Record (EHR). The contribution of this work is to investigate one of the significant issues related to the introduction of EHR: information overlap in actual documentation. The findings and implications of the study may contribute to an interdisciplinary documentation practice in the EHR that is patient-centered, safe, timely, efficient and equitable.

1.1 Motivation and Background

The motivation for investigating the interdisciplinary documentation practice and information overlap stems from several interests, including observations and experience starting from the early eighties as a nurse anesthetist and head nurse in two large hospitals in Norway. In my opinion, the paper-based nursing documentation systems available throughout these years have not appropriately kept up with emerging technologies to support health care work and the ever-increasing complexity and magnitude in diagnostics and patient care. The nursing documentation procedure of including updated patient information manually copied from the medical records seemed time consuming and inefficient.

The collaboration of nurses and physicians as *actually* shared, documented assessments, evaluations and health care interventions was, and has continued to be, more or less absent. The two professionally separated documentation systems might lead to incomplete, fragmented documentation and risk of information flaws. Consequently, my interest has been initiatives to improve the documentation system. My involvement in the development of an EHR system named DocuLive Electronic Patient Record, and the implementation process of a nursing documentation system in a large hospital setting in Norway spurred my interest in the potential benefits – and challenges – of a common interdisciplinary documentation system.

As a coordinator of communication among health care providers, the common interdisciplinary documentation carries potentials as catalyst for a more efficient in-patient

documentation process. Such processes require a unique set of patient information as well as access to relevant, common components of the EHR (Brunt et al., 1999; Guite, Lang, McCartan, & Miller, 2006). Despite different roles and responsibilities, nurses and physicians use the same core of patient information for decision-making and treatment. A unified, consistent, efficient and accurate interdisciplinary documentation in the EHR may therefore become essential in order to maintain quality in patient care (Abrahamson & Rosenthal, 1995; Agrawal & Johnson, 2006; Hardstone et al., 2004; Hayrinen, Saranto, & Nykanen, 2007).

Nurses and physicians are key professionals in today's complex health care environment that is in constant change and transition. Collection and processing of patient data and information communication and information exchange between nurses and physicians are crucial for quality care and desired patient outcomes (Knaup, Bott, Kohl, Lovis, & Garde, 2007). Healthcare professionals perceive significant gaps between information needs and timely access, and communication difficulties are commonly linked to poor outcomes. While physicians and nurses have different needs, methods and goals, they share common problems in obtaining information and communicating effectively. Unfortunately there are few studies that characterize the types of information, or the methods of delivery that are critical to prevent latent errors (Boustany & Caldwell, 2007).

Occurring errors and implications, as well as the benefits of an EHR system, are probably best represented by how nurses and physicians perform their documentation of patient care from a professional perspective. Of particular interest is the extent of information overlap in the charted notes. This can increase the understanding of how professionals exchange and evaluate patient data and utilize common patient information for their care and treatment. The accuracy of information is particularly important in this perspective. Studies of health care quality and patient safety repeatedly report effective communication and timely access to information as crucial factors for coordination of care and patient safety (Hayrinen et al., 2007; IOM, 2003). At the same time, studies indicate that major challenges in current documentation practice relate to information overload; a time-consuming documentation process, data redundancy and information overlap in the health care providers' charted notes in the EHR (IOM, 2001). In this dissertation, information overlap is defined as follows (by author):

Information overlap is duplication of data and information collected by nurses and/or physicians relating to a patient phenomenon, which is charted independently and stored in separate parts of the EHR.

Information Technology (IT) plays a central role in redesigning the health care system and has substantial influence on improvements in health care quality (IOM, 2001). There are ongoing transitions in health care following the introduction of IT that influence most aspects of care and treatment processes. Therefore, IT can be seen as a policy instrument for the advancement of health care organizations and as a driving force in the development of modern medicine. The challenges in IT innovation are considered 20 % technological and 80 % sociological (Scott, Rundall, Vogt, & Hsu, 2007). This implies that ongoing IT deployment should include consideration of environmental, health, human interaction and safety implications, as well as engineering, ethics and professional responsibility. In this study, however, professional responsibility and safety implications in continuum of care are main considerations. Exploring current documentation practices in the EHR by nurses and physicians will shed light on professional scopes and differences as well as safety implications in terms of information flow.

In Norway, transition from a paper-based to a computerized documentation system started in the beginning of 1980s for the General Practitioners. EHR systems for hospital organizations were developed and implemented from the late eighties and throughout the nineties. The EHR is a longitudinal accumulation of health information about individual patients' care and treatment over time, stored in an electronic repository (Gunter & Terry, 2005). Today, all health care organizations in Norway have implemented EHR, although the implemented systems vary regarding design and functionality, vendors and type of health care delivery supported (Christensen & Grimsmo, 2008; Harbaugh, 2007; KITH, 2001). The EHR support the continuation, efficiency, continuity and quality of integrated health care. Quite often deployment of the EHR leads to a redesign of delivery systems, improved care and more interdisciplinary documentation and collaborative care planning. This can also contribute to "... care that is safe, effective, patient-centered, timely, efficient and equitable" (IOM 2001, p. 7).

The accumulated information in the EHR will express a retrospective as well as a prospective planning perspective. The design and use of EHR in health care services may have a major impact on how health care professionals' process, exchange and store patient

information. For the nursing and medical community, development of IT in general and introduction of the EHR in particular offer new tools and methods for information exchange and storage. The international standards of health care documentation and information exchange in the EHR promote interdisciplinary access and exchange of information as a key to quality care and future patient-clinician relationship (IOM, 2003; ISO 215 Technical report, 2003; KITH, 2001; Nystadnes, 2001).

Few quality management systems in health care focus on health care providers' practice of information sharing and information flow, or chart duplications and redundancy in the EHR (Quillfelt, 2005; Wang, Hyun, Harrison, Shortell, & Fraser, 2006; Westbrook, Braithwaite, Iedema, & Coiera, 2004). However, several published studies suggest dynamic, interdisciplinary documentation models, using standardized terminology as a common framework to support improved and efficient documentation practice (Ahlfeldt, Ehnfors, & Ridderstolpe, 1999; Friedlin & McDonald, 2006; Gremy & Degoulet, 1993; Hardiker, Bakken, Casey, & Hoy, 2002). So far, these suggestions and recommendations have had meager influence on the interdisciplinary documentation and use of shared templates by nurses and physicians (Handler, Holtmeier, Metzger, Taylor, & Underwood, 2003; Haux, 2006). The current documentation models in available EHR systems in Norway do not include any shared terminology, charting templates, or notes appropriate for use by both nurses and physicians. Professionally segregated charting prevails, reflected as separate sections for the professions' notes (Amatayakul, 2005; Helleso & Ruland, 2001; KITH, 2001). This is an example of continued profession-based documentation practice where the profession determines how and where the information is entered to the EHR.

A review article on the impact of EHR reporting the time that nurses and physicians spent on documentation illustrates that increased documentation time is a frequently reported finding. This is an obvious barrier to the successful implementation of an EHR. Further research should shift focus from users' efficiency to system efficiency (Poissant, Pereira, Tamblyn, & Kawasumi, 2005). The benefits of the EHR are still widely approached from the user's perspective, looking at single processes (e.g. documentation) rather than on its impact on the set of processes involved in care delivery. Future research is required to examine the capacity of the EHR to improve the overall care delivery process of patients, and barrier associated with the additional time required to use the system is likely to be

outweighed. This implies a future EHR system that is accessible, reliable and supportive of clinical work processes and decision-making.

Significant problems in terms of information redundancy, timely access to patient information and interdisciplinary utilization of patient data challenge implementation and use of an EHR, and pose challenges to improvement of quality aspects of care. So far, the interdisciplinary documentation perspective and the actual presence of information overlap in the charted notes have not been sufficiently examined in the EHR from a scientific and professional point of view.

Exploring information overlap in the EHR requires authentic written text from nurses and physicians. One of the major challenges in auditing charted notes in the EHR has been the poor quality and quantity of the notes (Afantenos, Karkaletsis, & Stamatopoulos, 2005; Deursen van, Koster, & Petkovic, 2008). For this dissertation, I explore and compare admission and discharge summaries written by nurses and physicians on the same patient in the EHR, since these documents relate to the same situation.

1.2 Objective and Research Questions

The focus of this dissertation was to assess clinical documentation practice in the EHR in order to contribute to an interdisciplinary documentation practice in the EHR that is patient-centered, safe, timely, efficient and equitable.

The primary objective was to describe some aspects of interdisciplinary clinical documentation practice by nurses and physicians in the EHR, with emphasis on information overlap and information flow. A secondary objective was to develop and validate an instrument for assessing degree of information overlap and similarities between nurses and physicians.

The dissertation explores the following three research questions:

- 1) To what degree is there information overlap between nurses and physicians in documentation of patient care in the EHR?

- 2) In documentation of patient care in the EHR: Which information items between nurses and physicians are common?
- 3) How large is the time delay between accessibility of nursing and physician documentation of patient care in the EHR?

1.3 Outline of the Dissertation

To answer the research questions the dissertation is organized as follows.

Chapter 1 presents an introduction to the background of IT and EHR in health care settings. Moreover, this chapter includes motivations and background for the topic of the dissertation (section 1.1), followed by objective and research questions (section 1.2) and the outline of the dissertation (section 1.3).

Chapter 2 presents the framework of the study with identification of literature (section 2.1). The presentation of findings is organized within the interdisciplinary (section 2.2) and technological perspective (section 2.3). At the end of this chapter, a conclusion is presented (section 2.4).

Chapter 3 presents the design and methods in this dissertation with an overview of the research design (section 3.1). The research setting is presented in section 3.2 and materials in section 3.3. Further on, the EHR systems at the study sites are presented in section 3.4 and developed instruments in section 3.5. The next sections present the instrument development process (3.6) and validation procedure (3.7). Section 3.8 presents methods measuring information flow and accessibility of the charted notes. Ethical considerations are presented in section 3.9. The last section is a summary of Design and Methods.

Chapter 4 presents the outcomes from the instrument development process and validation. A characteristic of the sample is presented in section 4.1, followed by the outcomes of the three step item identification process (section 4.2) and validation of the instrument (section 4.3). .

Chapter 5 presents the outcomes of measuring information overlap and flow. Section 5.1 presents measurements of information overlap in the admission note (5.1.1) and discharge summary (5.1.2). The next section presents the outcomes of measuring information flow in terms of time delay (5.2) in the admission note (5.2.1) and discharge summary (5.2.2).

Chapter 6 presents synthesis of findings from literature and the study related to the dissertation's objective and research questions: Instrument development process and validation (section 6.1), information overlap and professional scopes (section 6.2) and information and accessibility of charted notes (section 6.3).

Chapter 7 concludes the dissertation highlighting findings with recommendations for further development (section 7.1), contributions to knowledge (section 7.2) and limitations (section 7.3).

2.0 REVIEW OF THE LITERATURE

This chapter aims to review significant literature and research in order to elaborate and frame the research questions for this study. The core elements of the literature review are to 1) explore the documentation practice by nurses and physicians in the EHR in the perspectives of information overlap and 2) to explore the information flow in terms of accessibility of the charted notes in the EHR.

The topic of the dissertation taps into many aspect of nursing and medicine, such as the scientific approach to knowledge, professional identity, social and legal incentives and the exertion of the discipline. The research questions involve specifically technology, information and communication sciences. This is a relatively new and evolving research area for health care disciplines.

The identification of literature focuses on key areas in this dissertation; information science and technology, interdisciplinary communication, information flow and clinical documentation practices between nurses and physicians in the EHR. These key areas are essential to elaborate and to answer the research questions. An article search in PubMed on the topic “nursing informatics” illustrates the research activity within information sciences and health. The search performed in 2009 returned 1 794 articles published on the topic “nursing informatics”. It is therefore necessary to limit the review to topics that are significant for the state of the art in relation to the research questions. The selection process of relevant literature for this dissertation is in the first section of this chapter.

In section 2.1, the method and overviews from the literature search is presented with distribution of types of articles and professional affiliation. In section 2.2, the identified literature is presented according to the core elements of the research questions structured into following main topics/headings: *the interdisciplinary perspective*, including information flow and documentation (2.2.1), communication (2.2.2), information overlap and redundancy (2.2.3). *The technological perspectives* are outlined in section 2.3, including information technology (2.3.1) and the Electronic Health Record (2.3.2). Finally, a summary is outlined at the end of the chapter.

2.1 Identification of the Literature

The identification of the literature is based on three major sources of information: 1) from a search of articles published from 1995 to 2008, 2) from books and grey literature and 3) from legal requirements. An *update* on recent publications has been performed in 2013. The additional search adds the concept of information flow in terms of accessibility and availability of the charted notes in the EHR as well as an update of publications on key areas of the literature review on interdisciplinary communication and documentation in the EHR and information overlap. The new search on main topics did not reveal any instruments/studies measuring information overlap between nurses and physicians in the documentation of health care in the EHR.

The literature from books and grey literature have been retrieved from literature search and the ongoing subscriptions and the following main database search, as well as unpublished material from the internal standards and regulations within the hospital organization at the main study site (UUS, 2005).

The Norwegian legislations and standards assessing documentation requirements of health care delivery and EHR stem from online resources (HOD, 2001b; HOD, 2001a; HOD, 2009; KITH, 2001). International standards and regulations of the EHR are also from online resources, mainly from the International Organization for Standards (ISO). The standards provides international technical specifications for EHRs (ISO 215 Technical report, 2003; ISO 9001, 2008; ISO/TC 176, 2004) while ISO 18308 describes EHR architectures. The ISO standards together with International Electro technical Commission (IEC) have significantly elaborated the role of information technology in health care settings in this dissertation. The role of IT relates to design, performance and quality of IT systems and tools, as well as information security, interoperability and user interfaces. The ISO standards do also include quality management systems requirements (ISO 9001, 2008). ISO is a voluntary organization whose members are recognized standard authorities, each one representing one country. 2700 technical committees, subcommittees and working groups, do the bulk of the work of ISO. Each committee and subcommittee is headed by a Secretariat from one of the member organizations.

The initial literature search in the databases for this dissertation was limited to articles published from January 1995 – September 2008. The following databases were searched: ACM Digital Library, Cinahl, Cochrane and Pub Med/Medline. The reason that publications before 1995 are not included in the article search, is mainly connected to the introduction of computerized health records in the early nineties in Norway, and that nursing documentation was not fully integrated in the Norwegian EHR until the year 2003 (Helsetilsynet, 2009; Laerum, Ellingsen, & Faxvaag, 2008). However, the first EHRs began to appear in USA in the 1960s. By 1965, at least 73 hospitals and clinical information projects, and 28 projects for storage and retrieval of medical documents and other clinically-relevant information were underway (National Institutes of Health, 2006).

To organize the identified literature from the article search the material was categorized into six different article types; *Research articles*, *Review articles*, *Conceptual articles*, *Project articles*, *Proceedings and Comments/Editorials*. The category *research articles* include all types of research designs and methods. Although the categories *review article* and *conceptual article* represents a research article, it is of importance to show the diversity of articles and the source of knowledge. The category *proceeding* was used to gain an overview of what is happening in the area, the work in progress, future directions and issues in the field. However, the ACM Digital Library represents a vast collection of newsletter articles and conference proceedings and is the most comprehensive content database in the field of computer science (Ghosh, 2008). Within this context, proceedings weight equal to traditional research articles. The use of the category *comments/editorials* highlights major concerns and discussions in the field. In some cases, the categories overlap, but the articles are only categorized once.

The inclusion criteria for the final selection of articles were that at least two of the following five concepts/terms/phrases were present in the abstract/heading of the article:

Patient record (including the terms computerized health records, electronic health records/electronic patient records, medical records, nursing records), *Interprofessional documentation and communication* (including the terms multidisciplinary, multiprofessional, teamwork, interdisciplinary, interprofessional), *Nurses or physicians*, *Information technology* (including health care information systems/clinical information systems, nursing informatics, medical informatics, health informatics) and *Information*

overlap/redundancy (including information overload). The following table displays the distribution on types of articles related to the databases:

Table 1: Database search results in types of articles

Database	Initial Search results	Selected articles	Research Articles	Review Articles	Conceptual Articles	Project Articles	Proceed	Comments Editorials
Pubmed/Medline	176	37	24	1	5	6	2	4
Cinahl	435	60	25	2	7	6	4	9
ACM Digital Library	36	8	1				7	
Cochrane Library	38	2		2				
Total	683	107	50	5	12	12	13	13

The initial article search resulted in 683 articles before the application of the inclusion criteria. Application of the inclusion criteria reduced the amount of selected articles to 107. Table 1 shows that the largest number of articles (n=107) falls within the category of *research articles* (n=50), followed by articles within the category of *proceedings* (n=13) and *comments/editorials* (n=13). The category *project articles* have an amount of 12 articles. In addition, *conceptual articles* are well represented in this material with 12 articles. There is few *review articles* represented (n=5) in this material. The distribution of type of articles presented in this material displays the variety on publications in this field with a majority of research articles.

The main empirical material provided for this dissertation stem from a Scandinavian country, Norway. Thus, it is important to review the research activity, concerns and relevance of the search topics for this context. The total number of Scandinavian articles in this material is 25, as displayed in table 2. It is also relevant for this dissertation to identify scopes of research in this area, since the results and comments are applicable to the Norwegian environment and therefore to some extend comparable. Categorization of professional affiliation makes it possible to show the relationship between nursing and medicine regarding numbers of articles, the number of collaborative articles, and to specify

the numbers of articles produced within the environment of nursing or medical informatics. The categorization also makes it possible to show the contribution from other disciplines or research areas in this field. The retrieval process of professional affiliation was through judgments of the professional titles of the author(s) together with type of journals, publisher and location. The categorization process in the material resulted in retrieval of the following nine professional affiliations: Nursing (N), Medicine (M), cooperation Nursing and Medicine (NM), Nursing Informatics (NI), Medical Informatics (MI), Sociology (S), Information Technology (IT), Computer Engineering (CE) and Law (L). The following table displays the distribution of professional affiliation to types of articles represented in the material, including Scandinavian articles:

Table 2: Distribution professional affiliation to types of articles

Professional Affiliation	Types of Articles Divided in total amount (Tot) of articles and Scandinavian articles (Sc)													
	Research		Review		Conceptual		Project		Proceedings		Comments Editorials		Total	Total *Sc
	Tot	*Sc	Tot	*Sc	Tot	*Sc	Tot	*Sc	Tot	*Sc	Tot	*Sc		
Nursing (N)	27	14	3	0	4	0	8	2	9	2	10	0	61	18
Medicine (M)	8	0	1	0	1	0	0	0	2	2	0	0	12	2
Nursing and Medicine (NM)	3	1	0	0	1	0	0	0	0	0	0	0	4	1
Nursing Informatics (NI)	3	0	0	0	2	0	1	0	0	0	2	0	8	0
Medical Informatics (MI)	6	0	1	0	1	0	1	1	3	2	1	0	13	3
Sociology (S)	1	1	0	0	1	0	0	0	0	0	0	0	2	1
Information Technology (IT)	2	0	0	0	0	0	2	0	1	0	0	0	5	0
Computer Engineering (CE)	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Law (L)	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Total	50	16	5	0	10	0	13	3	16	6	13	0	107	25

*Sc: Scandinavian articles

Table 2 shows that the nursing profession contributes importantly to this material, since as many as 61 of 107 articles are categorized within nursing and eight articles from the nursing informatics field. Cooperative work between nursing and medicine is present in four articles in this material, indicating an interdisciplinary collaboration in this field. In the articles

categorized to the medical profession, only 12 articles are present, and 13 articles are present in the medical informatics field. This means that the total amount of articles regarded as research articles in this literature review are 81 out of 107 articles.

2.2 The Interdisciplinary Perspectives

The interdisciplinary perspective elaborates the inter-professional relationship between the nursing and medical profession when it comes to documentation of health care in the EHR. Inter-professional work tries to replace the existing division of labor and power structures through a commitment to equality and collective responsibility. Failure to implement collaborative work has led to the fragmentation of care, patient dissatisfaction and poor outcomes (Henneman, 1995; Kenny, 2002). The concept *interdisciplinary* involves approaching a subject from various angles and methods, eventually cutting across disciplines and forming a new method for understanding a given topic (Klein & Herskovitz, 2007). The topic of interest in this study is the interdisciplinary documentation practice in the EHR between the two disciplines of nursing and medicine.

The overall assumption of the interdisciplinary approach in this dissertation aligns with perspectives on knowledge production that unites various methods through a focus on a common subject or problem. As a result, interdisciplinarians comprehend in complementary relation to one another. The roots of the interdisciplinary concepts stem from a number of ideas that resonate in modern discourse, such as notions of a unified science, general knowledge, synthesis and the integration of knowledge (Hurrelmann & Laaser, 1995; Klein J.T., 1991; Repko, 2008).

The modern connotation of *disciplinary* is a product of the nineteenth century and is linked with several forces: the evolution of modern natural sciences, the general “signification” of knowledge, the industrial revolution, technological advancements and agrarian agitation (Klein, 1991). The nursing and medical profession emerged from the nineteenth century, shaping the cultural and professional characteristics of the two professions.

A profession arises when any trade or occupation transforms itself through the development of formal qualifications based upon education and examinations. Typically, this is accompanied by the emergence of regulatory bodies with powers to admit and discipline members and some degree of monopoly rights (Johnson, 1972). A profession implies an academic degree that prepares the holder for a particular profession by emphasizing competency skills, along with theory and analysis. Nursing and medicine are typical examples of professions that are licensed and regulated by a governmental or government-approved body (Hoogland & Jockhemsén, 2000). However, medicine is among the oldest classical professions together with Divinity and Law (Perks, 1993), while nursing did not enter the professional arena before Florence Nightingale (Nightingale, 1860) elaborated the foundation of professional nursing through her work to improve conditions of soldiers in the Crimean War.

Interdisciplinary collaboration is “an effective interpersonal process that facilitates the achievement of goals that cannot be reached when individual professionals act on their own” (Bronstein, 2003, p 299). This definition reflects the interprofessional relationship between nurses and physicians engaged in work-related activities. One of the core components of this relationship is interdependence. To function interdependently, professionals must have a clear understanding of the distinction between their own and collaborating professionals’ roles and use them appropriately. This can be exemplified in a clinical setting where a physician provides the nurse with an assessment of the patients’ medical needs, which the nurse relies on to develop an effective discharge plan. The advantages of interdisciplinary collaboration is rooted in the belief that reliance on others for certain tasks and resources allows collaborators to spend their time doing what each knows and does best (Abrahamson & Rosenthal, 1995; Bronstein, 2003). A strong professional identity and clearly understood roles are important components of successful interdisciplinary collaboration. Both of these qualities are precursors for interdependence; nurses and physicians need to be secure in their own roles to know what they can offer and, in turn, what they can rely on the other to provide (Bronstein, 2003; Mattessich & Monsey, 1992).

The interdisciplinary approach to health care delivery aligns with improved planning, more clinically effective services and enhanced problem solving. However, there are strong indications in the literature that health care professionals tend to operate in their uni-

professional silos, and that attempts to share knowledge across professional borders are often unsuccessful (Margalit et al., 2009; Martin, O'Brien, Heyworth, & Meyer, 2005; Michel-Backofen et al., 2005). Against this background and in the context of this dissertation, the next section explores important aspects of the relationship between nurses and physicians.

While nurses document, collect and distribute information throughout the care of the patient, the physicians do have a slightly different approach to documentation and patient care. As Ralph Z. Kern, MD, expresses (Physician Documentation Expert Panel, 2006b): “As a physician, you are the key to providing the information that your patients, other physicians and the system need”. According to this statement, the core aspect of gathering and processing information in the medical field is intra-disciplinary and not particularly related to other collaborating health care professionals. The following citation from the poi-wg (Point Of Interest Working Group) blog provided by the AMIA (HIMSS task force, 2007) in December 2008, illustrates important points of the current state and relationship between nurses and physicians’ documentation practice:

Recently, at a steering committee meeting, I brought up the idea of using nursing generated content (from admission assessment and other nursing documentation) to populate or facilitate documentation by physicians and other clinicians in an EMR (Electronic Medical Record). The nurses in the room vehemently objected to this, as did the physicians. I wonder: do physicians even look at the documentation generated by their nursing colleagues?

Since much of the content of an H&P duplicates what the nurses collect on their admission assessment, why not populate the H&P with some of that information? The physician could validate it with the patient if necessary and then add what they need to add? Why should patients have to be asked and answer the same questions by a nurse and a physician?

What is it about nursing and physician culture that makes this idea objectionable? (Goldstein et al., 2008).

The statement immediately generated a response flow from nurses and physicians stating numerous conflict areas between nurses and physicians. Interestingly enough, the objections were stronger than the approvals and based on crucial issues of change of workflow, a conflict with established organizational culture, clinician roles and power relationships. In

the end, the core question was inter-professional trust. The physicians strongly argued that they wanted to gather and process the information themselves, even information from other fellow physicians.

2.2.1 Information Flow and Documentation

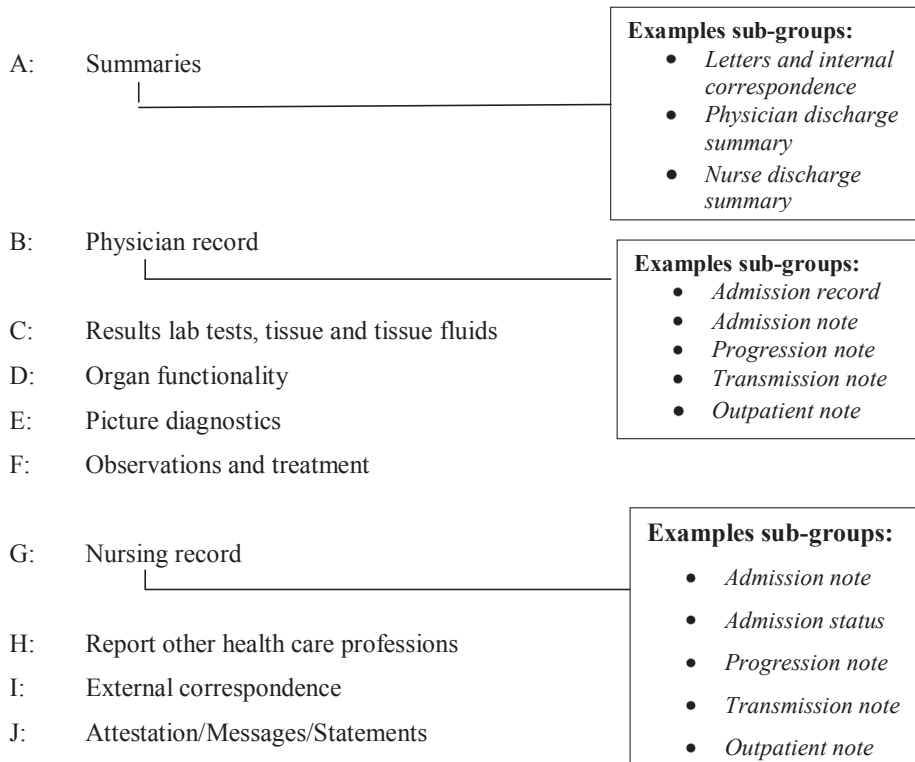
Information flow in healthcare is becoming more complex as additional information technology systems are added which may shift the role of the healthcare provider or eliminate signals that aid in planning and/or preparing for an upcoming event. With any transition or handoff of patient care, there must be complete and accurate transfer of all relevant information regarding the patient to the party that is assuming responsibility for the care of that patient. Patient care transitions have been shown to be critical points at which failures in patient treatment is related to breakdowns in the information flow process (Beach, Croskerry, & Shapiro, 2003).

Throughout the inpatient hospitalization period, numerous pieces of patient information are generated, passed along and reviewed by various providers. Accurate and timely flow of information through the inpatient period and in transitions across care settings, is vital to ensure safe and high quality care (Carayon, Wetterneck, Springman, & Ayoub, 2006; Clancy, 2006).

There are a number of serious shortcomings in the communication between healthcare providers that can cause risks for patient safety. The typical examples are a lack of communication between for example the anesthesiologist and the surgeon involved in the same surgery; repetitive over writings of variable data, such as blood pressure, with no information when, in which circumstances and by whom the measurements were performed (Schultz, Carayon, Hundt, & Springman, 2007). The use of “no message — good message” principle in the communication between caretakers provides insufficient information for patients about their treatments and expected developments. Several studies posit that association exist between transitions and increased risks of patients experiencing an adverse event, particularly in patient transitions from the hospital to home or long time care (Perry, 2004; Wears et al., 2004; Weir et al., 2011). Mobility and transfer/changing site of care occur in a variety of settings, as the patient moves from provider to provider in the outpatient setting to the emergency department of a hospital and to the inpatient setting.

They may transition from hospital unit to unit to discharge to a rehabilitative or nursing home setting. Health care providers, whether they are new to the patient, or have provided care at an earlier point in time or other setting, may not be aware of most recent events leading up to the transition. Transitions require a handoff, with a specific set of tasks to be completed by the next provider assuming care. In this setting, the nurses and physicians record a transition note (in-hospital) or a discharge summary (out-hospital) (Helsetilsynet, 2009; KITH, 2004; KITH, 2007). This can include the need to follow up on pending results or need for confirmatory testing. The handoff may also define which treating physicians are responsible for which of these follow-up tasks.

The process of charting information in the Norwegian EHR is based on a structure of the information that has been adopted and transformed from the paper based patient record. The structure was presented as a recommendation from the Norwegian Board of Health Supervision in 1991, also called the Norwegian Record (Helsetilsynet, 2009). The Norwegian Record is structured on main topics as follows (HOD, 2000).



Documentation

Documentation in health care is the charting, recording and reporting of events which occurs during patients' hospitalization. The accumulating history includes documenting admission, progress, responses to treatment and care, health education, discharge summary and incident reports (Helsetilsynet, 2009; HOD, 2001a; HOD, 2009).

Nurses and physicians have a long tradition in documentation. Florence Nightingale (1820-1910) stressed documentation and reporting issues in “Notes on Nursing” (published in 1859). Nurses were trained as a careful observer and a clear reporter, expected to keep precise observations records of the patient (Fischbach, 1991). The content and concept of nursing documentation have changed and developed in line with the general changes in society, medicine and the development of nursing as a profession and science. The development and changes in nursing documentation has gone from simple handwritten notes aimed for the physicians to legal independent professional documentation. The nursing documentation is based on demands and professional standards of how and when to chart health care, the nursing process and the visibility of the independent nursing patient care (Coombs, 2004).

It seems to be a common approach to documentation practice in nursing and medicine, named the problem solving process. The SOAP (Subjective-Objective-Assessment-Plan) approach was developed as a structured system for clinical examination of a patient to facilitate a comprehensive analysis of clinical problems and to develop differential diagnoses that culminates in a treatment plan (ISO 215 Technical report, 2003; Larimore & Jordan, 1995; McCloskey, 1975; Weed, 1975).

The SOAP approach is also in line with the legal and local requirements of documentation in the EHR (HOD, 2001a; KITH, 2004). However, in the current EHR at the Norwegian study site, the SOAP approach has not culminated in a treatment/medical plan or a problem based/process oriented documentation practice by the physicians. The SOAP approach, except from the plan component, is the common structure of documentation in the North American VistA EHR by nurses and physicians. The components of the SOAP model of documentation are as follows:

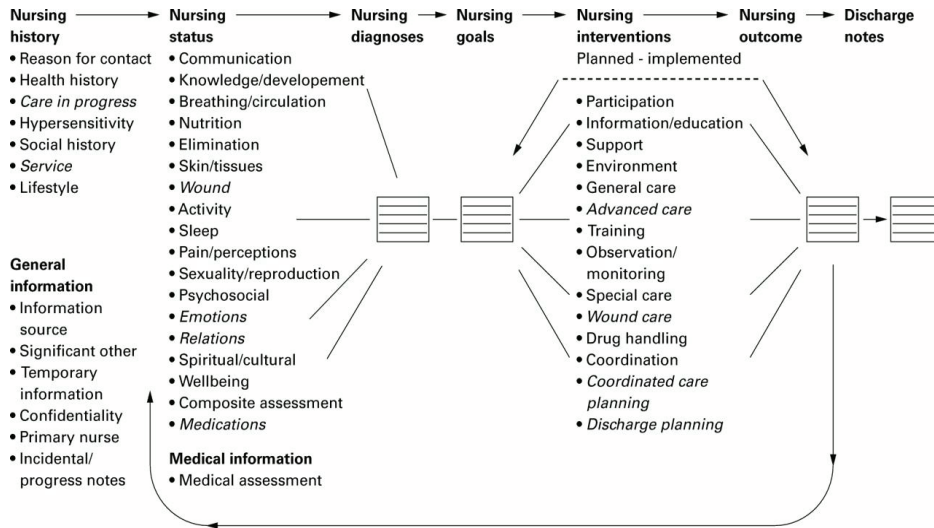
Table 3: SOAP components

	Components	Description
S	Subjective component	Describes the patient's current condition, pertinent medical history, surgical history, family history, social history, current medication and allergies. The history or experienced symptoms are recorded in the patient's words.
O	Objective component	Includes vital signs, findings from examination and results from laboratory tests.
A	Assessment component	A quick summary of the patient status, main symptoms/diagnoses, list of tentative or differential diagnoses.
P	Plan component	Contains the health care provider's suggested treatment of the patient's concerns. Advice given the patient and what actually led to recommendations and interventions are encouraged. Timing for further review/evaluation or follow up may be included.

Derived from Weed 1975 and 1993; edited by author

The VIPS model (Ehnfors, Ehrenberg, & Thorell-Ekstrand, 1998) was chosen by the Norwegian national group SykIT (SykIT, 2000) to structure documentation of nursing practice in the EHR. The model offers a low level of standardization and rests on the problem based nursing process. The VIPS model has key words on two levels and subdivisions in three areas and defines seven steps of documentation. The VIPS model is highly applicable to structuring nursing documentation in the EHR by offering a structure, i.e. the nursing process.

Table 4: The VIPS model



(Ehnfors et al., 2006)

As displayed in table 4 and 5, the SOAP and VIPS model contains the same core areas of assessment to patient treatment and care following the problem-based process including data collection, judgments, problem identification (diagnostics), interventions and outcomes.

It is a challenging task to describe the complexity and variations regarding the current documentation practice by nurses and physicians. Nurses are at all times processing almost any type of notes, nursing plans, individual plans, prescriptions and orders from physicians and other health care professionals. They are the core information collectors in the EHR (Papathanasiou, Kotrotsiou, & Bletsas, 2007; Sahlstedt, Adolfsson, Ehnfors, & Kallstrom, 1997; Walker & Prophet, 1997; Walsh, 2004). The physicians are documenting the diagnostic process, surgical and medical procedures and ongoing status of the patient in treatment, using various types of notes characterized more as core information producers than collectors in the EHR (Friedman, Halpern, & Fackler, 2007; Gremy, 1983).

Nurses and physicians process the patient information in different manners into the EHR, due to different approaches and tasks regarding the care of the patient. Nurses are the only profession within the health care system that has a 24-hour, 7-day-a-week-service throughout the entire hospitalization period. This of course affects the way nurses document, not only how and when, but also the content and scope of the documentation. Historically, nurses have always transcribed their notes directly into the patient record, and the only change in this approach is the actual tool in use. With the introduction of a computerized documentation tool, the pen has changed to the keyboard. The physicians, on the other hand, have not traditionally transcribed their notes directly into the patient record, but have made use of dictation devices and transcription support from secretaries (Orthner, Scherrer, & Dahlen, 1994).

A voice recognition tool converting spoken words to machine-readable input is implemented at a large scale at the Norwegian study site, primarily for the physicians to improve time spent on documentation and secure timely accessibility of the physicians' notes. However, more investigation is necessary to establish the benefits of a digital voice recognition tool in documentation regarding time reduction, quality and cost benefits towards transcription services (Health Devices, 2002; Meystre & Haug, 2005).

Standardization of documentation of health care has been highly actualized and developed after the introduction of computerized documentation and information processing tools in the clinical environment (Bakken, 2006; Ehnfors et al., 1998). A standardization of for example the nursing process in the EHR enables researchers, administrators and the clinical nurse to not only enter the data more accurately, but also to make relevant judgments of patient care and to retrieve patient data and compare outcomes in individuals and to a larger population. Missing data, unreliable data and incomparable data make it impossible to include nursing information in databases for quality improvement and health services research. In nursing, the standardization issue in documentation can be traced to the introduction of the nursing process, and it has been heavily criticized as an ideology of positivism and empirical analytic perspectives in nursing, with blurred theoretical implications (Betts, Ward, Murray, & Docherty, 2003; Martinsen, 1993).

In particular, the nursing plan has been criticized as meaningless and time consuming. It has also been pointed out that the nursing plan or the nursing process only acknowledges the

problem solving aspect of nursing (Fagermoen, 1993; Martinsen, 1993). Virginia Henderson (Henderson, 1982) is questioning the term “nursing process” and is strongly arguing that all health care providers use this analytic process, but at the same time takes into consideration that nursing interventions are also based on intuition. In nursing, the chief tool of communicating patient care has been the written nursing care plan (Henderson, 1982; Hyde et al., 2004; Kim, 1996). However, there has been confusion as to its use and value, not in the theoretical agenda, but usage and value in the clinical field (Ehrenberg, Ehnfors, & Smedby, 2001; Moen, Hellesø, & Olsen, 1997; Muller-Staub, Needham, Odenbreit, Lavin, & van Achterberg, 2007; Poissant et al., 2005).

The traditional nursing care plan has been criticized as time consuming and that it does not represent the actual workflow in clinical practice. It is strongly argued that the nursing plan is almost invisible in the patient record; while there is planning, there are no plans. It is also pointed out that nursing plans need to be constantly updated and that it is not an administrative planning tool in nursing care. To the contrary, the nursing plan is a time consuming process for pedagogical purposes. Several authors believe that there are better ways of communication and the nursing care plan should be integrated in an already existing interdisciplinary plan module/tool (La Duke, 2008; Munkvold, Ellingsen, & Monteiro, 2007).

The literature also suggests that more attention must be given to the nurses’ role and documentation practice, particularly when redesigning documentation tools. A tight and strong relationship between nursing and information services is seen as necessary to have a documentation system that works (Hagland, 2006; Hronek, 1995; Leth, Hostrup, & Thulstrup, 2005). In medicine, however, the physicians have continued their documentation approach reflected in templates with headings, and the problem solving process and treatment/care plan approach have not been as prominent as documentation method (Timmermanns, 1998).

Two articles on the topic documentation contain a discussion on theoretical aspects of documentation practice. The first article discusses how nursing documentation is a manifestation of a ritual of power relations in a discourse analysis, by exploring nursing practice through the text of documentation. Nursing disappears to the reader of patient records, and this discursive construction removes them from visibility. Recognition of

nurses' oral traditions and relative invisibility in the patient record is seen as evidence of resistance (Heartfield, 1995). Secondly, a method of evaluating computerized nursing documentation using reference terminology models is demonstrated (Moss, Coenen, & Mills, 2003), indicating the potential value of reference terminology. The decomposition of intervention terms into the categories of International Organization for Standardization (ISO) model proves to be a useful exercise in determining compliance with the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO, 2007) requirements for the documentation of pain standards. The weakness of this approach is that nurses use present form to describe nursing interventions and within this documentation context, there is no guarantee that the planned interventions are implemented. The author recommends, for example, the use of past form in the charted note when interventions are implemented and present form when interventions are suggested.

Discussion on computerization and the effect on interdisciplinary documentation begin from a nursing perspective and agree on methods of achieving interdisciplinary documentation by using a nursing intervention classification system, care plans and interactive assessment tools (Kjeken, Bjor, & Westerlund, 2008; Smith & Smith, 2002; Wenzel, 2002). Accessibility to the patient record is also of importance when discussions on interdisciplinary documentation in the EHR are present.

Nursing Documentation Practice

The literature seems to re-iterate that nursing documentation practice does not meet all desirable legal or professional requirements (Bjorvell, Wredling, & Thorell-Ekstrand, 2003; Ehrenberg & Ehnfors, 1999a; Einarson, Moen, Donasen, & Helleso, 2001; Stokke & Kalfoss, 1999). Furthermore, the nursing process and pedagogical activities are not evident in the charted notes (Aling, 2006; Friberg, Bergh, & Lepp, 2006; Karlsen, 2007; Leth et al., 2005; Nilsson & Willman, 2000). Documentation of nursing outcomes is usually missing in the charted notes or difficult to capture when auditing the nursing records. The consequences of this documentation practice make it almost impossible to measure and evaluate nursing care. Because the information is fragmented and poorly structured, audits of the content of nursing documentation becomes complicated. Therefore, the researcher has to seek information on a specific patient problem in-between a written text in all nursing notes in the EHR (Bormark, 2003).

Audits of Swedish patient records carried out in 1999 and 2005 are also quite conclusive; no records meet all the requirements of national regulations regarding judgments, aims, and evaluation and planning, and there is a vague and fragmented documentation of nurses' pedagogical activities in the patient record (Ehrenberg & Ehnfors, 1999b; Friberg et al., 2006). The aim of the studies was to 1) examine descriptions of some common and serious patient problems in Swedish nursing home records and 2) to identify terms and expressions indicating patients' need for knowledge and understanding, as well as nurses' teaching interventions, as documented in nursing records. The researchers compared the results to the requirements of Swedish law and found that no records contained a systematic and comprehensive assessment of any selected problems based on established legal and professional criteria. The last study showed major deficiencies in nursing documentation in the patient records, and the pedagogical activities in the patient records were fragmented and vague. However, these studies are on the documentation practice by the nursing profession in the EHR. Studies on the documentation practice by physicians or the interdisciplinary documentation practice in the EHR are not present in this material.

Physician documentation practice

Studies have also reported many ineffective procedures related to chart documentation by physicians. One of the most frequently reported concerns is individual physician practices. Documentation is used more as a tool to recall events rather than as a means to justify treatment decisions. This retrospective perspective often leads to lack of completeness, accuracy and timeliness in completing charts (Foster, Paterson, & Fairfield, 2002; Holmboe & Hawkins, 1998). The EHR is a powerful communication tool between physicians across the continuum of care. Physicians drive the information in the patient health record, which ultimately gets translated into data and information upon which important health care decisions are made (Physician Documentation Expert Panel, 2006a). However, many studies have reached troubling conclusions about the quality of patient health records and physicians' documentation. Too often they are incomplete or inaccurate, or important patient information is not passed on to subsequent physicians in a timely or useful manner (Martin, 1992; Physician Documentation Expert Panel, 2006b; Poissant et al., 2005; Scott et al., 2007; Simon et al., 2007). In other words, the literature reports a major challenge in

documentation of health care that legitimates increased focus on and need for a change in nurses' and physicians' documentation practice.

Reference Terminologies and Classification

There is an overall trend in the material suggesting that the nursing and medical documentation would benefit from implementation of templates, documentation models and standards. This is an important factor to a successful and accurate documentation practice (Bricon-Souf & Newman, 2006; Helleso, 2006; Larrabee et al., 2001). This view is in line with the suggestions for a common multi-professional conceptual model (De Clercq, 2008b) as a basis for interdisciplinary documentation of health care in the EHR. Studies on documentation of health care delivery by nurses and physicians show that structured EHRs can result in less time consuming data entry, improved quality and records that are useful in daily clinical work. It is also of importance to notice that nurses and physicians seem to prefer structured data entry in the EHR (Kjeken et al., 2008; Kruger, 2007). However, how this data entry should be organized and structured regarding common terminologies and content of the written notes is not discussed in this material, except from the common multi professional conceptual documentation model presented in section 2.3.2 (De Clercq, 2008).

The variety of services that nurses perform has militated against easy definitions of nursing practice or nursing phenomena. As a result, documentation of nursing care in patient records has been idiosyncratic and unstandardized. Although nurses spend from 25 to 60 percent of their time documenting patient care, the names they give problems, goals, interventions and outcomes vary among patients, nurses, times and settings (Ozbolt, 2000; Pabst, Scherubel, & Minnick, 1996). The medical community however, has a long tradition of classifying diseases and medical diagnosis. The first edition of ICD (International Classification of Diseases), known as the International List of Causes of Death, has its origin in the 1850s. The World Health Organization (WHO) launched the sixth revision, which included causes of morbidity, in 1948. Today, the ICD is the international standard diagnostic classification for all general epidemiological, many health management purposes and clinical use. These include the analysis of the general health situation of population groups and monitoring of the incidence and prevalence of diseases and other health problems in relation to other variables such as the characteristics and circumstances of the individuals affected, reimbursement, resource allocation, quality and guidelines (WHO, 2011a).

The World Health Organization (WHO) has developed a suite of classification products called Family of International Classifications. This suite is usable in an integrated fashion to compare health information internationally as well as nationally, and the focus is, among others, the multi-dimensional aspects of health. There are four reference classifications in the WHO Family: The International Classification of Diseases (ICD), International Classification of Functioning, Disability and Health (WHO, 2009), International Classification of Health Interventions (ICHI) (Odenrants, Ehnfors, & Grobe, 2005), and lately the International Classification of Nursing Practice (ICNP) has been included. The reference classifications or terminology referring to main classification on basic parameters of health, have achieved broad acceptance and official agreement for use, and have been recommended as guidelines for international reporting on health (Madden R., Sykes C., & Ustun T.B., 2007).

Classification is the act of forming a phenomenon into a class or classes, a distribution of groups according to some common relations or affinities. ISO 17115 defines a classification as “an exhaustive set of mutually exclusive categories to aggregate data at a pre-described level of specialization for a specific purpose” (Madden et al., 2007, p. 2). Internationally agreed classification in health care facilitates the storage, retrieval, analysis, interpretation and comparison of health and health-related data (WHO, 2011b). However, there are different levels of abstraction between for example the ICD and ICNP classification. The latter system is built on the nursing process with hierarchical construct of classes including nursing diagnosis, interventions and outcomes of nursing care. The ICD, however, classifies main internationally approved terms of medical diagnosis. In addition, the ICD information is used for management, health financing and general health system administration (WHO, 2011b; WHO, 2011a).

The reference terminology SNOMED CT (Systematized Nomenclature of Medicine - Clinical Terms), is a systematically organized computer process able collection of medical terminology covering most areas of clinical information (SNOMED CT, 2009). SNOMED CT was developed to support the community of practice developing EHRs, which will allow the appropriate retention, processing and exchange of unambiguous clinical records. Reference terminologies are fundamental to provide semantic operability, a consistent exchange of clinical information between different health care providers. When writing up this dissertation the WHO organization announced in July 2010 that the harmonization

between the WHO family of classifications and SNOMED CT was concluded as a complementary tool between terminologies and classifications. In the era of computerization of health information and EHRs, it represents a major achievement (WHO, 2011a).

Classification systems in nursing are not implemented on a large scale in Norway and are partly in use at the North American study site. However, several nursing classification systems are now translated into Norwegian (Mølstad, 2009). However, classification of health care and common terminologies are often regarded as crucial to achieve the aim of an interdisciplinary documentation practice that is safe, equitable and efficient in the EHR (Bricon-Souf & Newman, 2006; Smith & Smith, 2002). Therefore, it is significant for this literature review to elaborate on nursing classification systems.

The Norwegian Nurses Organization's Terminology Group (Mølstad, 2009) developed criteria for and evaluated five classification systems in nursing. The evaluation criteria were derived from national and international resources; particularly the criteria of CPRI from 1996 (Computer-based Patient Record Institute), ISO 18104:2003 reference terminology standard and the National strategy of quality improvement in the Social and Health services from 2005. The following table shows an overview of the nursing classification systems evaluated by Norwegian Nurses Organization's Terminology Group (Mølstad, 2009):

Table 5: Overview nursing classification systems

1	NANDA: North American Nursing Diagnosis Association This is the oldest classification system in nursing and covers only the diagnostic part of the nursing process. The system is licensed and is not electronically available.
2	NIC: Nursing Intervention Classification This is a classification only for nursing interventions. The system is licensed and is not electronically available.
3	NOC: Nursing Outcome Classification This is a classification only for aims and outcomes in nursing and must be used with NANDA and NIC to cover the total nursing process. The system is licensed and is not electronically available.
4	CCC: Clinical Care Classification The system is a framework with a code structure of nursing diagnosis, aims, interventions and outcomes. Application is needed for usage, but it is not licensed and is electronically available.

5	<p>ICNP: International Classification in Nursing Practice</p> <p>A classification of nursing phenomena, nursing actions and nursing outcomes describing nursing practice. Developed by the International Council of Nurses (ICN) has compatibility with ISO 18104 and is the only nursing classification system adopted by the WHO Family. ICNP is licensed (nominal fee) and electronically available.</p>
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The Norwegian Nursing Organization recommended the ICNP for nursing practice to be implemented in the Norwegian EHR systems (Mølstad, 2009). The reason for this recommendation was that ICNP is made for EHR systems; it contains a flexible reference terminology owned by ICN. The users of the classification system can influence further developments and refinements. The terminology implies concepts commonly used in nursing practice that are valid in spite of different specialties, language, countries and cultures. The recommendation is of significant importance in future developments of the nursing documentation system in the EHR, and is a major input of significance to the main topic in this dissertation; interdisciplinary documentation and implementation of common terminologies as a means to a safer and efficient health care delivery.

Documentation Practices and utilization EHR

Ubiquitous access to the patient record can reduce documentation errors, preparation time, improve information quality and nurses working environments (Abraham, Watson, & Boudreau, 2008). However, there are some underlying disciplinary visibility aspects of interdisciplinary care that need to be discussed, and it is the promotion of greater collective mind of care enhancing continuity of patient care (Keenan & Yakel, 2005).

Shared notes and how this is benefiting clients, professionals and careers were early issues in the literature. Later on the development of interdisciplinary computer-based documentation systems in multidisciplinary teams are major concerns (Fuller, 2006; McKelvie, 1997). The issue of interdisciplinary documentation with shared notes is not explored sufficiently in the literature, the benefits are clear, but how to implement shared notes in an EHR is not explored in this material. One of the objectives in this dissertation is to explore and measure information overlap between nurses and physicians by identifying shared and common conceptual areas. This will contribute to the construct and implementation of shared notes in the EHR.

It is also pointed out by many that the computerized documentation itself is not enough to secure the quality of nursing documentation; the introduction of a computerized tool does not change or improve the content of the information (Bricon-Souf & Newman, 2006; Stokke & Kalfoss, 1999; Thoroddsen & Ehnfors, 2007). In order to improve and secure the quality of documentation, identification of key areas in nursing care is crucial for accurate and reflective nursing records. To secure patient centered care, standardization of the assessment of language and communication is necessary (Nailon, 2007; Thomas, Sexton, & Helmreich, 2003). However, there are indications that there is no time decrease or benefits using templates in the charting process or computerized documentation (Boldreghini & Larrabee, 2000; Marill et al., 1999), but streamlining the documentation and the use of a universal records increase nurse clinicians' time with patients (Beyea, 2003; Smeltzer, Hines, Beebe, & Keller, 1996).

A universal record has some core capabilities to transform data into information that clinicians use to make decisions. The following five hallmarks of this transformation process are enumerated below (Tang & Hammond, 1997):

- Integrated view of patient data
- Access to knowledge databases
- Physician order entry and clinician data entry
- Integrated communications support and
- Clinical decision support

The five hallmarks are also reflected in the multi-professional conceptual documentation model (De Clercq, 2008), which will be described in section 2.3.1. In particular, the description of workflow in the documentation model gives an overview of how data can be transformed into clinical usage between nurses and physicians. Although these five hallmarks are desirable for a common conceptual documentation model, they are not as far as I know implemented in a large hospital setting. Further research and validation is therefore urgently needed, in particular on the content of the charted notes, common terminologies and cultural and professional issues between nurses and physicians (Asp &

Petersen, 2003; D'Amour, Ferrada-Videla, San Martin, & Beaulieu, 2005; Davidson, Egbert, Merchant, Padgett, & Rankine, 2004; De Clercq, 2008b; Moss et al., 2003).

There are indications in the literature that implementation of nursing theories and models in clinical practice has a positive impact on nursing documentation, but the implications on nursing workflow and documentation processing is not discussed (Bricon-Souf et al., 2006; Leth et al., 2005). The results reveal some major areas for future research and the real impact of implementation of nursing theories and models in clinical practice is unknown.

Summary Information Flow and Documentation

Accurate and *timely* flow of information through the inpatient period and in transitions across care settings is vital to ensure safe and high quality care. Patient care transitions have been shown to be critical points at which failures in patient treatment is related to breakdowns in the information flow process. In particular the transition from hospital to home care is critical. Transitions require a handoff, with a specific set of tasks to be completed by the next provider assuming care. In this setting, the nurses and physicians record a transition note (in-hospital) or a discharge summary (out-hospital). The Norwegian EHR is structured into separate records for nurses and physicians that again are divided into several types of notes/documents. These types of notes have more or less the same labels. As an example of relevance to this dissertation, the structure in the Norwegian EHR lacks an interdisciplinary documentation system with shared documents and therefore does not support or provide a common terminology. This is illustrated by the inpatient documentation flow on patients with upper hip fractures at the main study site. The information flow is parallel between the two professionals. The literature reveals some problematic issues regarding the nursing and medical documentation practice in the EHR. The main view on nursing documentation practice is that information is fragmented and poorly structured, and documentation of nursing outcomes is usually missing. Many studies have reached troubling conclusions about physicians' documentation, reporting documentation as incomplete or inaccurate where important patient information has not been passed on in a timely or useful manner. Nurses and physicians share a common approach to documentation of patient care, named the problem-solving process, exemplified by the SOAP and VIPS models. The introduction of EHRs has changed assessment patterns on entering and retrieving patient data, but the computerized tool itself is not enough to secure the quality of documentation. Standardization of the assessment of language and communication, such as implementing a

common reference terminology, has a positive impact on the quality of patient care. However, there are indications in the literature that there is no time decrease or benefits using templates in the charting process or computerized documentation. Further research on the content and organization of the documented notes is recommended. The issue of shared notes has not been sufficiently explored in the literature, and studies on documentation in the EHR do not reflect medical judgments and decision-making between nurses and physicians. Studies on the core issue of this dissertation, exploring interdisciplinary documentation in the EHR is not present in this material.

2.2.2 Communication

Communication is the activity of conveying information. Communication requires a sender, a message and an intended recipient. The communication can occur across vast distances in time and space. Communication requires that the communicating parties share an area of communicative commonality. The communication process is complete once the receiver has understood the message of the sender, and feedback is critical to effective communication between parties. Each information exchange is a communication act, whether it is exchange occurring between two people or two machines (Bokhour, 2006; Cox, 2000; Toussaint & Coiera, 2005).

Improving communications and collaboration among nurses and physicians can improve patients' satisfaction and quality of care (Vazirani, Hays, Shapiro, & Cowan, 2005). Traditionally within the health informatics area, the focus is representation and storage of information and design, particularly regarding the health record systems. Over 90 % of the information transactions do not involve stored electronic data but face-to-face conversation between clinicians (Coiera, Jayasuriya, Hardy, Bannan, & Thorpe, 2002). This may have a major impact on the ability of a computerized patient record to improve information processes (Toussaint & Coiera, 2005).

Tradition, professionalism and practice boundaries continue to be obstacles to collaborative documentation practice (Taylor-Seehafer, 1998). Guideline driven care practice and increased usage of shared terminology can be useful in diminishing these boundaries. Clinical guidelines are systematically developed statements to assist practitioner decisions about appropriate health care for specific clinical circumstances (IOM, 1990). Guidelines

are used to reduce inappropriate variations in practice and to promote the delivery of high-quality evidence-based health care (CRAG (Clinical Resource and Audit Group), 1993). Guideline driven care is also effective in changing the process and outcome of care (Thomas et al., 2000). A synthesis of relevant research from the domains of clinical guidelines and medical informatics strongly suggests that the operational support provided by computerized patient record systems will have a major impact on physician compliance with clinical guidelines (Elson & Connelly, 1995). In an interdisciplinary perspective, implementing clinical guidelines and shared terminology in the EHR may contribute to decrease professional boundaries and communication barriers.

A finding across this selection of articles indicates an overall benefit of the interdisciplinary communication and documentation systems on efficiency, patient safety, work satisfaction and quality improvement of patient care (Green & Thomas, 2008; Hammer, Snorrason, & Langeland, 2002; Keenan & Yakel, 2005; Lingard et al., 2004; Martin et al., 2005; Morrison et al., 2001; Smith & Smith, 2002; Vazirani et al., 2005). The benefits of developing enhanced methods of communication among interdisciplinary health care professionals are numerous. Patients' outcomes and organizational efficiency might improve. The method of enhanced communication simplifies the ways in which individuals perform their respective duties and less time is spent managing communication (Milligan, Gilroy, Katz, Rodan, & Subramanian, 1999). However, it is also important to take into consideration the cultural and communication barriers between nurses and physicians and other members of a multidisciplinary team, particularly the discrepancy in attitudes about teamwork (Makary et al., 2006; Thomas et al., 2003). Communication barriers between for example primary care and hospital organizations may create information gaps and result in incomplete patient assessments being made on admission (Cox, 2000).

Interdisciplinary Communication Patterns and Systems

An investigation was carried out by Schoop and Wastell (1999) on a geriatric ward concentrating on nurses and physicians communication patterns. Empirical data on communication patterns in cooperative healthcare was collected during ethnographic studies to identify causes of common problems in interdisciplinary communication. These empirical investigations provided a good understanding of work practices and group work, especially of causes of communication breakdowns in cooperative environments. The authors conclude

that the most obvious communication problem is misunderstanding between nurses and physicians because of different terminologies or misinterpretations. This challenge of appropriateness and comprehensibility can be described as follows: the nurse has the relevant knowledge about incontinence according to specific nursing professional concerns. This knowledge is different from the physicians' medical knowledge. The physician states that the detailed utterances of the nurses are inappropriate, while nurses argue that every detail of their answer is relevant to them and assume that this is the same for the physicians. On the issue of terminology, the investigation revealed that nurses and physicians have different terminologies, but both overlap. The characteristics of physicians' notes are formal, short terms and sentences, while nurses use simpler whole sentences and have a narrative style. Differences in values and standards are also a challenge to the truth and appropriateness of the information.

The authors (Schoop & Wastell, 1999) also provide an approach to the design of Cooperative Documentation Systems (CDS) to represent intra- and interdisciplinary communication structures. CDS support cooperation between different professional groups by accommodating information exchange mediated by shared documents. However, the design is largely based on intuition and has not systematically addressed all communication and cooperation in a multidisciplinary setting. The authors are pointing out that a more theoretically rigorous approach is required, focusing especially on potential sources of communication breakdown. This work provides a theoretical basis for the development of new cooperative documentation systems.

The topic interdisciplinary communication and medical error are discussed in a literature review article (Alvarez & Coiera, 2006). Numbers of studies have highlighted the importance of communication and patient safety and the potential role of interruptive communication in latent medical errors. Bakken (Bakken, 2006) comments the article by concluding that in the interest of patient safety, basic research, theoretical perspectives and methods from a variety of disciplines must be applied to examine these questions. She concludes that the review article raises more questions than answers; particularly about the role of current and emerging communication technologies on communication patterns, what types of information that can effectively be communicated through asynchronous channels (e.g. e-mail, electronic task list) and through synchronous channels (face-to-face communication). However, the most important issue, according to Bakken (2006), regarding

interdisciplinary documentation, is the lack of a “gold standard” for good communication. Bakken also points out the question of what type of communication is optimal for patient safety. The lack of “gold standards” indicates that there are some undiscovered elements of how health care providers communicate in the EHR and lack of standards to guide this process. The main issue in this dissertation is to explore charted notes by the nurses and physicians in the EHR, which will shed light on how nurses and physician communicate asynchronously.

There are also concerns in the literature about human interface of nursing and medicine, extending the thinking about the value of interdisciplinary education beyond the traditional dimensions (Dellasega et al., 2007). Secondly, there are concerns about the role of the advanced practice nurse in collaborative practice and the development of a shared language by discussing the difficulties of communication within multidisciplinary teams (Milligan et al., 1999).

Cognitive perspectives

The following articles have a cognitive perspective on interdisciplinary communication and communication patterns related to different work organizations. In a study analyzing physician–nurse cooperation in administration processes (i.e. medication ordering) from a cognitive point of view two work organizations were compared (Beuscart-Zephir, Pelayo, Anceaux, Maxwell, & Guerlinger, 2007): 1) a synchronous cooperation characterized by common doctor–nurse medical rounds and 2) an asynchronous cooperation characterized by split physicians’ and nurses’ rounds. In the first situation, the nurses actively participated in the medication ordering process, while in the latter situation the nurse did not participate. Although written orders seem to be better documented, the nurses suffer from lack of knowledge about the patient’s medical case and in particular the context of medical decision-making. Shared knowledge about the patient was weakened in the asynchronous work organization. In other words, and significant for this dissertation, the authors concluded that the EHR documentation did not reflect medical judgments and decision-making between nurses and physicians. It is therefore essential to take into consideration when assessing nurses and physicians’ notes in the EHR, that medical decision-making is partly documented, but communication on this issue is mainly synchronous. It is also of importance to be aware of that the combination of interruptions and multiple concurrent clinical tasks may produce clinical errors by disrupting the memory process.

Summary Communication

The literature seems to converge toward a consensus that interdisciplinary communication is essential to improve patient care and the documentation practice. The reported communication problem between nurses and physicians relate to misunderstanding and use of different terminologies. About 90 % of the information transactions involve interpersonal exchanges, and this adds to the challenges for a computerized patient record ability to improve information processes. The core issue is the lack of “gold standards” and a definition of what type of communication that is optimal for patient safety. The role of emerging communication technologies on communication patterns is still unexplored. However, studies show that shared knowledge about the patient is weakened in the asynchronous work organization, characterized by split medical rounds where the face-to-face communication is missing between nurses and physicians. Use of interdisciplinary templates and interactive assessment tools enhances interdisciplinary communication and quality of care. The use of common terminologies and synchronous communication between nurses and physicians are essential to securing the information flow in the EHR. However, further studies are needed in regards to the role of emerging technologies on interdisciplinary communication.

2.2.3 Information Overlap and Redundancy

Information overlap is defined by the author as duplication of data and information, collected by nurses and/or physicians relating to on one patient phenomenon, charted independently and stored in separate parts of the EHR. Redundancy means “superfluous repetition or overlapping of words”. With regard to communication, redundancy is regarded as “inclusion of more words than necessary” (Online Dictionary, 2010).

On the technological side, the expressions “information overlap” and “redundancy” are more connected to the reliability of a computer-system. The following definition of redundancy is based on this approach (Sci-Tech Dictionary, 2009): “The use of more information that is absolutely necessary, such as the application of error-detection and error-correction codes, in order to increase the reliability of a computer system”.

The issue of general redundancy of information in the patient record has been addressed (IOM, 2003), in particular the issue of validity of collected patient data, continuous errors of misinterpretation and flaws in the data and medication errors. This approach is more related to system design and capabilities than the actual content overlap of the information in the charted notes by health care professions, which are the core issue of this dissertation. However, the specific issues of information overlap between nurses’ and physicians’ charted notes in the patient record have not specifically been approached in the literature.

The literature is mostly concerned with structural issues, document flow, documentation of similar care processes and transmission from paper-based to computer-based systems. Overlapping documentation is commonly reported from several health care settings; this is seen as inefficient and might be a major annoyance to those patients who are asked to repeat the same information, often within the same episode of care. Multiple forms documenting similar patient care processes and data integrity are also questioned when more than one provider collects the same data. This can lead to duplicate documentation, which can be the source of patient and staff frustration, as well as data errors (Cowden & Johnson, 2003). These authors conclude that creation of a process to help with consolidation, which is easily duplicated, is a boon to all nurse information scientists. The analytic and subsequent reporting processes used in this study provide a systematic method of forms of consolidation that can be applied in other settings. This is important foundational work and is essential for

easing the transition from a manual documentation system to a more standardized, automated system.

When updating the literature in 2013, new publications were detected on the issue information overlap in handoffs between nurses and physicians (Collins, Stein, Vawdrey, Stetson, & Bakken S, 2011). This is a review article published in 2011, and consequently, these elements were not taken into consideration in the instrument developing process in this study. However, the publication illuminates the issue of content overlap in handoffs artifacts that is highly relevant to this dissertation exploring interdisciplinary information flow and overlap. The authors examined handoff information and identified a 46 % overlap between nurse and physician handoff lists for hospitalized patients. The CCD (Continuity of Clinical care Health Information Technology Standards Panel (HITSP) C32) was useful for coding 80% of the hospital handoff information, and 12 hospital handoff codes were developed to categorize the remaining 20 %. The CCD was selected as the foundation for the categorization based on its acceptance as a patient-centered electronic information exchange standard and relevance to continuity of care. The interdisciplinary handoff element lists contained practical information, background information, planning information, and safety information that could be standardized and organized using the CCD framework in a centralized interdisciplinary EHR module. The authors conclude that the interdisciplinary handoff list may facilitate the establishment of common ground and interdisciplinary communication and decrease information loss, interruptions, and errors of omission. Further recommendations are that the standardization of EHR handoff tools uses the extended CCD sections, and comprise interdisciplinary modules that incorporate the interdisciplinary handoff information elements into *structured* narrative documentation. Further research must emphasize to investigate the impact of standardized interdisciplinary handoff information to clinicians at the point of care.

Paper-based clinical practice standards have a limited format and usually pertain to a single diagnosis or clinical condition. When a CPOE (Computer Physician Order Entry) system applies multiple paper-based practice standards to one patient, it generates an order list containing redundant orders (Roemer, Richardson, Sward, & Tilley, 2005). They report an example where orders from three practice standards were manually combined to create a single order list, resulting in 15 duplicates and overlapping orders. Multiple forms documenting similar patient care processes were commonplace in the North American

health care environment. Their system analysis was a preliminary step to transition from manual documentation to standardized, automated systems. In the transition from paper-based to computer-based patient record, multiple standards for one patient generated redundancy in the order list. However, the authors suggest that it is possible to automating the removal of duplicates before displaying it to the nurse. The study does not consider how nurses and physicians enter the data to the EHR, or the implications of a parallel order entry system administered by nurses and physicians.

The role of redundancy in a hospital setting is also discussed in this material (Cabitza, Sarini, Simone, & Telaro, 2005). A field study focuses on paper artifacts supporting health care and its coordination. The authors identified different types of redundancy, i.e. redundancy of effort, functions and data. There are both positive and negative aspects of redundancy, and this twofold nature defines different requirements for a technology to support health care. A paper reporting from an introduction of the electronic patient record for nurses in a Norwegian hospital is also present in this material. The major aim of the project was to formalize nurses' work related to handover conferences. Despite the project's proclaimed success, like reduced overtime, improved quality of the written documentation and elimination of redundancy, the final analysis demonstrates an opposite effect by reintroduction of redundancy. The authors found that work (and redundancy) in fact had moved to another time, into different artifacts, or old artifacts now were used/annotated differently (Munkvold, Ellingsen, & Koksvik, 2006).

Summary Information Overlap

The literature elaborates different types of redundancy that may have both positive and negative sides depending on whether it is related to efforts, functions or data. The twofold interpretation of redundancy calls for new requirements in technology supporting health care processes. The review showed that information overlap/redundancy between the charted notes of nurses and physicians in the EHR is only explored and discussed in relation to technological capabilities and system design in the EHR, only pointing to other core aspects like data reliability and errors of information input and medication. Redundant documentation can be inefficient, time consuming and an annoyance to the patient, who is questioned several times on the same issue by different health care providers. Multiple forms documenting the same care processes, and transmission to an electronic format generate duplications and relocate redundancy. The results show that there is substantial interdisciplinary content overlap. The authors conclude that interdisciplinary handoff list may facilitate the establishment of common ground and interdisciplinary communication and decrease information loss, interruptions, and errors of omission.

2.3 Technological Perspectives

The technological perspectives are drawn from literature on the topics “information technology” and “EHR”. This chapter seeks to elaborate the significance of technology related to interdisciplinary relations and documentation practices by nurses and physicians. Medical technology is often referred to as a “culprit in contemporary health care” (Timmermanns, 1998).

Medical technology innovations have significantly changed health care delivery and influenced patient outcomes through earlier diagnosis, less invasive treatment options and reductions in hospital stays and rehabilitation times. Medicine has embraced and utilized technology in order to diagnose, monitor, or treat every disease or condition affecting humans more sophisticatedly. These innovative, medical technologies are fundamentally transforming the health care landscape, providing new solutions to address chronic disease conditions and revolutionizing the way treatments are administered (Blumenthal & Glaser, 2007). Technology is connected to, and expresses values because technology has a purpose, and this purpose is connected to values (Hofmann, 2002). Therefore, IT in health care involves not only the technology itself, but also inscribed purposes and values of the technology, including human and social interaction interpretations. The following statement illustrates core elements and the complexity of contemporary nursing – medicine relationship to technology and professional values:

While the medical profession and health care administrators are attempting to expand the utilization of technological devices in medicine, members of the nursing profession are striving to cope with their humanitarian consequences. Therefore, nurses are trapped between two competing paradigms (Hewa & Hetherington, 1990, p 181).

In nursing, the relationship to technology has been more complicated and troublesome than in medicine. Some embrace technology, while for others; technology becomes a scapegoat, separating the human body and mind from the human touch. Technology is often labeled non-human in the nursing literature (Sandelowski, 1999; Sandelowski, 2000). Along this line of argument opposing technology, the efficient world of technology prevails over the particular and spontaneous world of people and functions to undermine expressions of caring.

The philosophical influences on how we perceive the world and make sense of our experiences can further illustrate the phenomena of technology and health care. In most discussions regarding technology, two separate and opposing positions have prevailed: humanists versus natural scientists and technocrats. An enemy picture often exemplifies this, where the natural science position (also labeled positivism) portrays the humanists as obscure illusionists and intellectual snobs. At the same time, the humanists label the position of natural scientists and technocrats as alienated, formalistic and even inhuman or immoral. There has been both indifference and lack of interest between the two positions (Felluga, 2003).

A representative of The Society for Philosophy and Technology: Joseph C. Pitt (Pitt, 1995) argues that it is not a question for or against technology. Evolution is a fact, and thus technologies are facts in our lives. The real issue, then, is how to talk about the role of our technologies in our culture and in our lives. Therefore, we need to talk in an informed and sensible manner about how our technologies make us what we are and what we can be. In short, we must turn our attention to seeing how it all comes together from the perspective of philosophers, not ideologists. Otherwise, we run the risk of being ignored and having our concerns taken over by others who are willing to address these issues. It is useful to reflect on how gender shapes, operates, or is implicated in the workplace (Davies, 1995). The nursing profession is a largely female-dominated profession (Eveloff, 2003), but the influential professional and organizational leaders, as well as technology corporate leaders, are often male. “When we think about IT we should consider more carefully who is developing the technology, and scrutinize if it is biased in that it is based on, and embeds, a masculine vision of work” (Davies, 1995, p 52).

The traditional tensions between humanism and technology are still obvious, although the scientific framework or philosophical foundation may be less clear. Technology is not only the traditional issue of submission and control, but also a question of admission and responsibility, a powerful human tool of knowledge development (Bormark & Moen, 2006). With this background, the following sections elaborate the topics information technology and EHR.

2.3.1 Information Technology

Information Technology (IT) is “the technology involving the development, maintenance and use of computer systems, software and networks for the processing and distribution of data” (Merriam-webster dictionary, 2010). In the 1960s and 1970s the term “IT” was a relatively unknown phrase that was used by those who worked in places like banks or hospitals to describe the processes they used to store information. With the paradigm shift to computing technology and "paperless" workplaces, information technology has come to be a household phrase. IT defines an industry that uses computers, networking, software programming and other equipment and processes to store, process, retrieve, transmit and protect information (Slamecka, 2010).

The IT literacy is the set of knowledge and proficiencies needed to acquire, categorize, store, retrieve and synthesize information competently in health care delivery (Dreher & Miller, 2006). The research activity and knowledge development within this area are fundamental to the understanding of how we utilize and shape future computerized health care delivery systems (Quinsey, 2006). IT is regularly cited as a means of improving the quality of the health care process and patient safety. There has been great expectation of increased efficiency, cost benefits and improvement of patient care due to digitalization of health care information. It is also a common expectation that an improved, more available, more exhaustive and precise documentation will prevent the risk of medical errors (Ball, Weaver, & Abbott, 2003; IOM, 2003).

The development of computers has led to increased digital information processing in health care organizations and to the development of *information science* that includes computational, cognitive and social aspects, including study of the social impact of information technologies. Information science research is basically concerned with how humans create, seek, retrieve and use information, particularly human interactions with information systems. In other words, information science is not only a technical, but even more so, a cognitive, social and situational process (Spink, 2000).

A new scientific field has evolved from the technology development called Informatics, which is the science of information, the practice of information processing and the engineering of information systems (Greenes & Shortliffe, 1990; Oxford English

Dictionary, 2008). The origin of the term *medical informatics* is a translation from French to a North American context. This took place in the fifties along with the development of microchips and computers. Homer R. Warner founded the first Department of Medical Informatics at the University of Utah in 1968, and from the seventies the coordinating body has been the International Medical Informatics Association (IMIA NI, 2009). Medical informatics is in the intersection of information science, computer science and health care. The scope of medical informatics is to examine attributes of information and gain insight to understand health related data, information and knowledge (Gremy & Degoulet, 1993).

Medical informatics is described as the scientific approach that studies the structural and general properties of scientific information and the laws of all processes of scientific communication (Berg, 2001). The terms Health Informatics or Health Care Informatics are also commonly used and understood as a broader domain of this field, while medical informatics is regarded as an intersection of the domain. Some of the main sub-domains are considered clinical informatics, nursing informatics, consumer health informatics, public health informatics and clinical research informatics (Goossen, Ed C., Epping, & Dassen T., 1997; Kane, Brewer, Goldman, & Moidu, 2006; Oyri et al., 2007).

The concept and essence of nursing informatics are outlined in order to emphasize the relevance of health informatics for this dissertation, exploring interdisciplinary documentation in the EHR as a sub-domain to health informatics, nursing informatics becomes a continuum based on a common scientific approach (Jamal, McKenzie, & Clark, 2009; Spink, 2000). The scope, however, is on the nursing profession and practice, focusing on the collection, analysis and use of nursing information to improve health outcomes. Nurse informaticians define the concept of nursing information as that of “information that is specific and necessary for nursing practice and research” (Strachan, Delaney, & Senmeier, 2006, p 507). Harriet Werley first introduced the nursing information concept in 1982 as the nursing minimum data set (Delaney & Clarke, 2002). She defined a set of 16 data elements that cover sociocultural data on the patient, problems assessed, interventions used and goals/outcomes and the care context (Werley & Lang, 1988).

However, it was during the 1960s that the nursing profession first took an interest in using computers. One of the pioneers from this period, Maureen Scholes (Scholes, Tallberg, & Pluyter-Wenting, 2002), summarizes the events and observations from this period and

illustrates the approach and attitudes by nurses and physicians to IT. First, there were initial doubts about the ability of nurses to use a computer, but the nurses were used to specialized equipment and the doubts subsided. Secondly, when system analysts talked to physicians about using computers in health care systems, the physicians envisaged possibilities for future use. However, the nurses could describe the current manual systems. Finally, the physicians were better at both writing about and speaking of the new projects emerging at that time. Moreover, they believed they could cover nursing. At this time, the emphasis was on nursing documentation, measuring and monitoring patient care, compiling nursing curricula, computer-assistant learning and resource management.

Computers also played a role in nursing research because of their ability to store and maintain large data banks. Today, nursing informatics are at the heart of development in healthcare informatics (Chambers, 2002). Such advances include development of information systems in nursing and hospitals (Epping & Goossen, 1997), development of classification systems in nursing (Hardiker & Rector, 1998; ICN, 2009), of data mining (Delaney & Clarke, 2002) and in recent years the emphasis on patient security, patient education and potentials of telehealth care (Chaudhry et al., 2006; Courtney, Demiris, & Alexander, 2005).

Nursing Informatics

Goossen (Goossen et al., 1997), defines nursing informatics as nursing information management and processing: a framework and definition for systems analysis, design and evaluation. Nursing informatics is, according to Goossen, the multidisciplinary scientific endeavor of analyzing, formalizing and modeling how nurses collect and manage data, process data into information and knowledge-based decisions and inferences for patient care, and uses this empirical and experimental knowledge in order to broaden the scope and enhance the quality of their professional practice. Others have described nursing informatics as a combination of computer science, information science and nursing science designed to assist the management and processing of nursing data, information and knowledge to support and delivery of nursing care (McBride, 2006; Sensmeier, 2007). According to Goossen (Goossen et al., 2004), the central focus in the scientific methods in nursing informatics is:

- Using a discourse about motives for computerized systems
- Investigating determinants, conditions, elements, models and processes in order to design and implement, as well as test, the effectiveness and efficiency of computerized information, (tele)communication and network systems for nursing practice
- Studying the effects of these systems on nursing practice

According to IMIA NI (IMIA NI, 2009), also named The Nursing Informatics Specialist Interest Group, nursing informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities worldwide. The core purpose of nursing informatics today is the management of information by nurses for the positive benefit of patient health care.

The overall issue regarding the evolving area of nursing informatics is according to the literature, to break free from the past by utilizing information science and technology, but capabilities of information science and technology are also discussed in the literature. In the field of scientific research, for example, the completion of the human genome forced researchers to become dependent upon the capabilities of information sciences and technology (Kane et al., 2006).

Utilization and participation in development of Computerized Information Systems

When exploring manual methods of patient-care, documentation improvement of safety requires changes in the system of care. Nurses and other caregivers have to free themselves from the manual chores that keep them from the bedside, and utilization of technology in the clinical field can contribute to increased time with the patients. Another aspect is the demand from patients and the general public of increased safety and better outcomes of health care (Shabot, 2003).

The planning and implementation of computerized information systems in nursing and medicine has historically taken little account of existing work processes. Nurses and physicians have had minimal involvement in the development process of technological

documentation systems (Elfrink, 1996; Shabot, 2003). This has led to abstraction of information from the nursing and medical context for the formal information system. The implications for nursing documentation and information exchange are that they still share information informally in for example shift handovers or in the ward environment. However, with the increasing use of nursing informatics, nurses will utilize computer technology to increase patient-nurses interactions and decrease redundancy of documentation. Many computerized documentation systems do not support nursing activity and decision making, so nurses need to ensure that they are configured to do so (Budgen, 2008; Gurbutt & Roberts, 2006). The implication for physician documentation practice has been, for example, that implementation of CPOE's (Clinical Physician Order Entry) systems has been problematic and opposed by physicians (Fischer et al., 2008; Friedman et al., 2007).

It is essential that nurses are involved in setting up electronic patient record systems so they support and demonstrate nursing activity. Nurses need to collaborate with other health care professionals to recognize the powerful tools and contributions of nursing informatics (La Duke, 2001; Shabot, 2003). Another important issue regarding the utilization and implementation of the new technology is the role of nursing informatics towards the health care industry and software vendors (Ballard, 2006; Belanger, 2006).

The results from the literature search also implicates the importance of health care professional's interest and participation in format design (Leisner & Wonch, 2006) and the process of modeling workflow in order to improve documentation practice (Corkery, 2007). Today, in addition to providing high quality patient care, nurses are required to document everything from past medical history to whether or not the patient wants his or her pastor notified of the admission. With stringent rules and regulations passed by legal and political authorities, nurses struggle with the requirements that are made on them to document complete and accurate patient information. As nurses enter into the era of computerization, it is important that nurses focus their efforts on improving nursing documentation through the use of computers instead of creating more work for themselves (Gapko, 2001).

A successful implementation of computer based documentation systems depends on input from health care providers to secure sufficient interface to support clinical workflow and documentation (Laughlin & Van, 2003). This article shares the efforts on improving nursing

documentation in a small rural hospital by using computers at the patient's bedside. The results showed that computerized documentation and information systems improved nursing documentation, and that nurses needed to be conscious of and participate in the system's development.

Expectations on wireless network

There are also concerns in the literature about the introduction, implementation and evaluation of a wireless network on communication and documentation in this material (Breslin, Greskovich, & Turisco, 2004; Cronin, Daly, Luttrell, & Murphy, 2003; Guite et al., 2006; Nahm & Poston, 2000). Inpatient healthcare delivery involves complex processes, which require interdisciplinary teamwork and frequent communication among health care providers. These workflow processes and communications are often inefficient, and the impact of wireless communications systems on these processes is expected to improve and support a better workflow and communication among health care providers. While many agree that today's technology has the potential of positively influencing nursing care delivery, few studies are conducted on the subject.

A comprehensive benefits study was conducted in 2003 to quantify the impact on a wireless hands free system on workflow and communications (Breslin et al., 2004). The results identified a number of significant findings, demonstrating its value from a quantitative and qualitative standpoint, but the results are at this point inconclusive, and the authors recommend further investigation of this issue.

Implications on workflow

Attention is paid to the evolutionary role of the nursing community and the redesigning process of nursing workflow in this material (Cronin et al., 2003; Elfrink, 1996; Kane et al., 2006; Shabot, 2003). The evolutionary role refers to the work of Florence Nightingale and the historical nursing role in changing the health work. Kling (Kling, 2003) states that IT applications are deeply embedded in questions of human values and that the socio-technical effects of IT applications are still not well understood. There are also some unintended consequences of IT in health care that are important to be aware of; the silent errors caused by the computerized health care system itself (Dykes et al., 2009). The errors are mainly related to entering and retrieving information, communication and coordination.

Systematic surveys and qualitative studies from the socio-technical field, including cognitive psychology and usability, show that the introduction of IT in health care has dramatic effects on work processes, especially where physicians' and nurses' tasks are concerned (Black, 2005; Dykes et al., 2009; Puskar, Aubrecht, Beamer, & Carozza, 2004). One such dramatic effect is the impact on interdisciplinary documentation practices in health care. However, the literature does not exemplify or clarify the impact on interdisciplinary documentation practices, and is recommending further studies in this area.

Although significant reduction of medical errors can be proven, such as adverse drug events, the changes engendered by the introduction of computer based systems may breed new errors that are difficult to anticipate and difficult to catch. However, in the long run, the creation of an electronic work environment with systems that integrate all functions of the health care team will positively impact cost-effectiveness, productivity and patient safety while helping to revitalize nursing practice (Ball et al., 2003).

Summary Information Technology

Nursing informatics are on the cutting edge of the transformation of health care systems to meet the huge challenges of delivering safe, sustainable, effective and efficient health care worldwide. The main concern from the nursing profession is the ability of an EHR to streamline and support the working-and documentation practices, while articles from the medical field emphasize innovation and technology in patient care and patient education. There have been great expectations in health care organizations and among health care providers regarding technology and the prospects of quality improvement of health care by increased efficiency, cost benefits and an improved, more available and precise documentation practice. The literature on the topic IT proposes that computerized information systems considerably improve documentation of health care. However, many computerized documentation systems do not support nursing and medical activity and decision-making. While many agree that today's technology has the potential of positively influence health care delivery, few studies are conducted on the subject. The socio-technical effects on IT applications are not very well understood. Several authors point out major concerns about the implementation of a computer based documentation system. The main concerns are that the systems may breed new errors that are difficult to anticipate and

difficult to catch. The impact of a computerized documentation system on interdisciplinary documentation practice is insufficiently explored in this material. However, the importance of collaboration with other health care professionals and participation in format design and the processing of workflow are crucial to improve documentation of health care. The growth and development of nursing informatics are linked to the evolution of nursing and its professional status.

2.3.2 The Electronic Health Record (EHR)

In the literature, the concept of EHR is quite unstable and the terms “Computerized Patient/Medical Records”, “Computerized Patient Record Systems (VHA office of Information, 2008)”, “Electronic Medical Records (EMR)” and “Electronic Patient Record (EPR)” are all used (De Clercq, 2008b; Hayrinen et al., 2007; Hayrinen et al., 2007). Internationally, the term Electronic Health Record (EHR) has gained prominence to reflect the numerous disciplines contributing information from many health care settings and complex health information involved in modern patient care (IOM, 2001). I therefore choose this term: Electronic Health Record (EHR), to reflect the evolving understanding of a computerized patient record.

The EHR provides a view of the patient’s accumulating health history. In other words, it provides a longitudinal record of the patient’s health status (sickness and wellness) including observations, measurements and history and prognosis, and serves as the legal document describing the health care services provided to the patient. It provides a method for clinical communication and care planning among the individual health care practitioners and supports documentation for the reimbursement of services provided to the patient. The EHR documents and substantiates the patient’s clinical care and serves as a key source of data for outcomes research and public health purposes. It also serves as a major resource for health care practitioner education and documentation of the quality of patient care (Amatayakul, 2001).

The development process of a common Norwegian EHR, the Medakis project, was initiated by the five directors of the main regional hospital organizations in Norway in 1995. However, the nursing record/documentation was not a part of the first specification of a common EHR, and the Chief Nursing Officers (CNO) at the main regional hospital

organizations initiated the SykIT project (Hellesø & Ruland, 2001). The aim of the project was to develop a common, integrated Electronic Patient Record (EPR). The SykIT task force reached consensus that the VIPS (Well-being–Integrity–Prevention–Safety) documentation model (Ehnfors et al., 1998) was highly applicable to structure nursing documentation in the EHR. The model offers a structure, i.e. the nursing process and keywords known by the staff nurses. This was important for further development of electronic nursing documentation in Norway. The opportunities for using classification systems, standards and/or free text in the EHR were opened. The specification of requirements for nursing documentation is now implemented in the EHR and is a part of the national EHR standards (KITH, 2001; KITH, 2004; Nystadnes, 2004). The EHR system DocuLive was implemented in the largest Norwegian hospitals because of the organization complexity, where many independent information systems already existed (Laerum et al., 2008).

Legislation and standards

The EHR serves as a legal document of the care and treatment provided to the patient. Moreover, it is a means of monitoring and evaluating staff performance of patient care and thus reflecting the standard of practice. Good charting must be concise, accurate, complete, legible, timely and logically organized. Concise and precise patient documentation is significant in providing quality care and ensuring continuity of care across disciplines (Amatayakul, 2001; De War, 2006; IOM, 2003; Knaup et al., 2007; Moen, Hellesø, & Berge, 2008). Documentation of health care is, according to Norwegian Regulations Patient Record (HOD, 2009):

Documentation of health care is recorded statements of the patients' need of health care. The documentation in the EHR, if necessary and relevant, shall contain observations, judgments, identification of patient resources and problems, expected results, interventions and evaluation. The documentation must be unbiased and objective and the language must be understandable. Abbreviation of professional terminology is not permitted.

All health care professionals have an obligation to document their health care deliberations and enactment, according to current legislation in Norway. The law regulates responsibilities, content and exchange of patient information (HOD, 2000; HOD, 2001a; HOD, 2009). The patient has one record accessible to authorized professions, and should be used by all health care professionals performing health care. The legislation does not distinguish between nurses and physicians. The legislation and governmental directions

recommend that future documentation systems must contain terms that have a patient perspective and contribute to patient participation. Current reports state that health care professionals have a potential of quality improvement in the documentation of health care (Helsedirektoratet [Directory of Health], 2009; Marill et al., 1999).

There is an overall aim by Norwegian Health Authorities to increase control and participation from the patient. In order to achieve this goal, it is of major importance that health care providers use common terms and synonyms that describe the patient's statements and expressions (Helsedirektoratet [Directory of Health], 2009; HOD, 2001b). The use of classification systems in health care can accommodate these requests and aims (ISO, 2005; Madden R. et al., 2007; Mølstad, 2009).

According to the International Organization for Standardization (ISO) definition (2003), the EHR is a repository of patient data in digital form, stored and exchanged securely and accessible by multiple authorized users. It contains retrospective, concurrent, prospective information, and its primary purpose is to support continuing, efficient and quality integrated Health care. The EHR definition from ISO is the primary definition of an EHR in this dissertation.

It is also consistent with the following Norwegian definition:

The electronic health record is an electronic collection of written and registered information about a patient's health care. The patient journals content should contain relevant and necessary information about the patient and health care, together with necessary information that fulfill a judicial obligation to report or inform. Normally, a patient should only have one journal within an organization. All categories of health professionals that perform health care must use (employ) this patient journal (KITH, 2001)¹

Many definitions of the EHR stress the notion that it is a longitudinal collection of personal health information, and although a standard definition is not provided, the following statement from ISO points out the EHRs longitudinal aspect:

¹Translated from Norwegian to English by the author and validated by Kathy Mølstad

- Retrospective: A historical view of health status and interventions
- Concurrent: A “now” view of health status and active interventions
- Prospective: A future view of planned health activities and interventions

According to ISO (2003) the key point of an EHR system is interoperability; the ability to share health information between different authorized users. There are two dimensions of interoperability of information: 1) Functional interoperability and 2) Semantic interoperability. Functional interoperability has to do with the ability of two or more systems to exchange information and semantic interoperability has to do with understanding the shared information at the level of formally defined domain concepts. It is of importance to understand that semantic operability depends on the level of agreement on terminology and the content of archetypes and templates used by the sender and receiver of information. Semantic interoperability is necessary for automatic computer processing in applications that support decision-making and care planning. The interoperability issue is a core factor for health care providers in supporting clinical workflow, communication and integration of patient health information in the EHR (ISO 215 Technical report, 2003; Nailon, 2007; Scott et al., 2007).

OpenEHR is an open specification in health informatics that describes the management and storage, retrieval and exchange of health data in EHRs (Beale & Heard, 2007). In short term it means that all health data for a person is stored in a "one lifetime", vendor-independent, patient-centered EHR. The specifications are maintained by the *openEHR* Foundation (OpenEHR foundation, 2013) supporting the open research, development, and implementation of open EHRs. The specifications include information and service models for the EHR, demographics, clinical workflow and archetypes. They are designed to be the basis of a medico-legally sound, distributed, versioned EHR infrastructure. The key innovation in this framework is to provide a powerful means of expressing what clinicians and patients report that they need to record, so that the information can be understood and processed wherever there is a need.

ContSys (ISO CEN ContSys, 2007) defines a system of concepts to support continuity of care. Continuity of care is an organizational principle that represents an important aspect of quality and safety in health care. Semantic interoperability is a basic requirement for continuity of care. Concepts that are needed for these purposes must represent both the

content and context of the health care services. In the article "Modeling shared care plans using ContSys and *openEHR* to support shared homecare of the elderly (Hägglund, Chen, & Koch, 2011), the authors describe how the European Standard EN 13940-1 for continuity of care and the reference model of *openEHR* were applied in modeling a shared care plan for shared homecare in Sweden. Their study shows that these requirements are matched by ContSys on a general level. However, certain attributes were not explicit in ContSys, for example agents responsible for performing planned interventions, and support for monitoring outcome of interventions. They further studied how the care plan conceptual model can be implemented using the *openEHR* reference model. The study demonstrates the feasibility of developing *shared* care plans combining a standard concept model, for example ContSys, with an electronic health records (EHR) interoperability specification (*openEHR*). It also explores the reusability of existing clinical archetypes as building blocks of care plans and the modeling of new shared care plan archetypes.

More than 20 years have passed since the first Norwegian hospitals introduced EHR to the point when the last hospitals obtained EHR. The implementation of EHR is complete in the specialist health services sector. However, "complete" may not be an exhaustive term, as EHRs are in constant development with respect to new functionality (NSEP [Norwegian Centre for Electronic Patient Records], 2008).

A survey of the usability of the EHR in hospital organizations, also named specialist hospitals, was performed by the EHR Monitor project in 2010 (NSEP [Norwegian Centre for Electronic Patient Records], 2011). The survey concluded that important clinical tasks were performed using the EHR, but clinicians often used paper as well. Among all health care professionals, 85 % answered that they always used the EHR to gain an overview of the patients' health condition. An amount of 75 % answered that they used the EHR for documentation purposes. Concerning other important clinical tasks, the use of an EHR was limited. The EHR Monitor project suggests that the reason for this could be usage of pen and paper or another ICT system than the EHR.

The purpose and problems of record keeping have focused on different aspects of documentation, legal and professional (Culley, 2001). The purpose of record keeping has often been related to communication for continuity of care, organizational and legal requirements and obligations to society, while the problems of record keeping have often

been discussed from the point of view of how professionals process and document health care and the interaction with electronic systems. Errors regarding medication, for example, often relate to lack of proper documentation of prescriptions by physicians, handwritten notes or oral messages (Bricon-Souf et al., 2006). However, a computerized documentation system compensates for some of the errors and omissions in the paper-based systems (Whyte, 2005).

User interface

It is pointed out in the literature that one of the major threats to patient safety is the lack of a common user interface in the EHR systems. In IT, the user interface is everything designed into an information device with which a human being may interact. This includes display screen, keyboard, mouse, light pen, the appearance of a desktop and how an application program or a Website invites interaction and responds to it (SOA definitions, 2008). The user interface is one of the most important parts of any program because it determines how easily you can make the program do what you want. A powerful program, like the EHR, with a poorly designed user interface has little value. The interfaces between systems can also be incomplete together with an insufficient user interface design (Amatayakul, 2009; Goedert, 2008; Heeks, 2005; Smith, Smith, Krugman, & Oman, 2005). Having a common interface, clinical staff can change their employment and still have some consistency of user interface and information presentation (Coiera, 2007).

Several authors stress the notion that well-implemented EHRs have the potential to improve health care, but we need to know more about cost-effective design, implementation and technical support of an EHR (Koppel, 2005; Walker, 2005). The complexity of health care makes it unlikely that large productivity gains will be achieved taking into consideration that it was not until the late nineties that widespread productivity gains could be attributed to IT expenditures (Hillestad, 2005).

One example of the inflexibility and inefficiency of an EHR system is that documents can be available electronically, but have no individual data elements that can be processed by a computer. In other words, you have to seek up manually the document where the information is processed and read the document. For example, during the documentation process the nurse only has an overview of the documentation by other nurses, and the physician only have an overview of the previous notes by other physicians. However,

allowing clinicians to view defined information about individual patients in a ‘virtual’ electronic patient record drawn from information held in different clinical systems can be one solution to the lack of information overviews. Easier access to this information will support improved care delivery and decision making and patients can be reassured that clinical staff have the information they have prioritized for safe care (Kuvås, 2010).

Information models

Most present EHRs are based on proprietary information models, and what many hospital organizations today call EHR is basically an electronic document management system (Amatayakul, 2005; ISO 215 Technical report, 2003). Among well-documented concerns about current EHRs are that they tend to be inflexible, non- intuitive, expensive, difficult to maintain and rarely interoperable across health systems (Haux, 2006; Hayrinen et al., 2007). From the clinician’s perspective, these problems in using an EHR system seem no better than retaining a paper-based system. The future alternative to proprietary EHR systems and a possible solution to existing problems are the *openEHR* functionality, as earlier accounted for in this section. This may help integrate a functional EHR system into, and across more health systems and clinics because of the greater potential for local customization (OpenEHR foundation, 2013; Yellowlees, Marks, Hogarth, & Turner, 2008).

When writing up this dissertation there has been a transition from the traditional proprietary EHR systems to open-source software. From the year 2011, the VistA EHR system, USA, has an open-source platform that embodies the clinical workflow processes that support VAHS’s (Veteran Affairs Health System) models of care. The EHR system supports the efficient capture, storage, and review of a full complement of clinical documentation, including patient assessment, progress notes, admission and discharge summaries, care plans, etc. CPRS workflows and templates guide clinicians through the capture of appropriate data at the point of care and ensure that complete and consistent data is captured (Moduro, 2013).

There is a qualitative shift from a closed system model for health care, where decisions are traditionally informed by the individual expertise of clinicians, to a more open model, where decision-making is informed by a number of sources both inside and outside the clinical setting. An EHR could be the hub of this information, supporting safer and more effective and efficient care management. However, this can only be the case if the clinicians are ready

and able to integrate IT into different models of care and clinical practice (Scott et al., 2007).

Studies regarding theoretical framework and models of documentation in the EHR are present in this material. A study exploring a biomedical model and framework for the EHR concludes that the model does not adequately support nursing decision-making. Although EHR increases information access and improves organization and efficiency, the EHR also increases documentation time, decreases interdisciplinary documentation and impairs critical thinking (Kossman, 2006).

Other concerns in the literature are quality assessment of information and support of the informality of information in the EHR. Information delay and overlap are considered a major threat to the quality of the charted notes in the patient record (Bormark & Lenert, 2006; Hardstone et al., 2004). The information overlap in the EHR is first of all time consuming and secondly shows a lack of coordination between health care providers in patient care.

Two review articles are viewing the nursing record systems and its effect on nursing practice and health care outcomes (Curell & Urquhart, 2003) and the impact of EHR and time efficiency (Poissant et al., 2005). The conclusion is that nurses need to be ready to share information systems as well as information with patients and colleagues, and that reduction of time spent on documentation is not likely to be realized in the EHR. Results of this review (Poissant et al., 2005) suggest that nurses are more likely than physicians to gain time efficiencies by using a computer system to document patient information. This is related to the transition from hand written notes to a computerized documentation system. The review also identified how the selection of bedside or central station desktop EHRs may influence documentation time for the two main user groups, physicians and nurses. Several issues may explain the difference between nurses and physicians regarding time usage in documenting health care in the EHR. First, nurses and physicians document different types of information. Nurses often document using standardized forms or care plans, while physicians rarely use standardized templates to write their clinical notes. The selection of various types of bedside or central station desktops might influence time efficiency, but sufficient system support of work processes in the clinical field is lacking.

De Clercq (2008) presents a conceptual model for a multi-professional EHR based on the problem-oriented patient record together with nursing theories. The model derives from National requirements of EHR in Belgium and international standards of documentation in the EHR (ISO 215 Technical report, 2003). The model is the only model for a multi-professional EHR identified in this material. Because of the relevance to the topic of this dissertation, the model will be thoroughly presented. The model builds on the relation between nurse and physician documentation of health care in the EHR. The core elements of a patient centered interdisciplinary documentation practice and the approach of designing a multi-professional model in the EHR underpin the significance and relevance of the research issues in this dissertation.

The development of the problem-oriented conceptual model relates to the significant growth of medical knowledge and increasing clinical specialization. Because of this, there may be as many documents or files in the EHR on a patient, as there are specialties involved in the patient treatment. The increased number of professions and specialties surrounding the patient also calls for improvement in the cooperation of data communication between them. Development of the EHR can be one of the tracks to achieve it. However, a common conceptual model is necessary to achieve the goal of developing EHR to support increased communication and cooperation between health care providers. De Clercq (2008) also points out that setting up a common conceptual model for nurses and physicians still remains relatively unexplored. There is little progress in the unification of basic EHR architectures with data for a wide range of disciplines.

The first step in the development process of the model was to identify nursing and medical data requirements to preserve nursing perspectives (more function-oriented and related to nursing actions) and medical perspectives (more related to pathologies). The perspective of nursing derives from Virginia Henderson's 14 basic needs and nursing diagnostic classification NANDA (North American Nursing Diagnosis), while the medical perspective derives from previous work on EHR architecture for general practitioners. The initial conceptual work was built as a new prototype for a multi-professional EHR system in the CORINES project by a multi-disciplinary team of computer scientists and health informatics specialists in nursing and medicine in Belgium. The model comprises of six basic concepts as displayed in the following table:

Table 6: Basic concepts for a multi-professional EHR

Basic concepts	Description	Nursing ←	→ Medicine
The health care element	First level of meta-information, patient oriented Can be identified by several professions, cooperation	Related mainly to one of the 14 patient basic needs. Main and secondary diagnosis, labeling the health care element	Pathology, main and secondary diagnosis linked to a health plan
The health approach	Belongs to one health agent Professionals work around the same health care element according to their own objectives		
The contact	Created when a service is recorded in the EHR and available to other health care providers	Drug prescriptions by physician accessible to nurse	Parameter recorded by nurse accessible to physician
The sub contact	Part of a contact dedicated to one health approach related to the same health element		
The service	Data heading. Related to several sub contacts and to several problems (health care elements)	Anamnesis Actions Drug administration Progress notes	Prescriptions Physical examination Anamnesis Technical acts
The health agent	A professional or group of professionals responsible for the content		

(Derived and processed from DeClercq, 2008b, adapted for this dissertation)

The model seeks to link nursing and medical perspectives and provides a common conceptual architecture for a problem-oriented EHR. The basic concept *health care element* can for example be identified by one of the professions (nurse or physician). Since the element does not belong to one specific profession, they can collaborate on the same health care element. For instance, a nurse may perform the action of administrating medication in response to the physician's prescription. Both prescription and administration of the medication may be recorded in the EHR related to the same medical problem. A physician can also perform an action in response to a *health care element* identified by a nurse. One example can be prescription of a feeding tube in response to a patient alimentary problem labeled a nursing diagnosis in the EHR. The physician will record the performed actions in

relation to the same nursing diagnosis. DeClercq (De Clercq, 2008b; De Clercq, 2008a) concludes that implementing an EHR is a step-by step process, while the core question is whether nurses and physicians are willing to share information and work under common health care elements. Communication between professionals will probably improve by using a common tool with a common conceptual structure. The model is partially validated, and although preliminary results are encouraging, further research on implications and international relevance is necessary.

Summary EHR

The EHR will compensate for some of the errors and omissions in a paper based recording system, but expectations of reduced time spent on documentation are unlikely to be realized. The key point of an EHR system is functional and semantic interoperability; the ability to exchange information between systems and to understand shared information at the level of formally defined domain concepts. The key innovation in the *openEHR* framework is to provide a powerful means of expressing what clinicians and patients report that they need to record, so that the information can be understood and processed wherever there is a need. According to this material, communication will most likely improve with a common conceptual structure, but the core question is whether nurses and physicians are willing to share information under commonly shared elements. Health care providers need to prepare for information sharing with patients and colleagues to improve health care outcomes. Significantly for the research questions in this dissertation, the literature review shows that measurements of information overlap between nurses and physicians in the EHR has not been recorded in this material. A conceptual model for a multi-professional EHR based on problem-oriented documentation models in nursing and medicine has been developed in Belgium, but has not been applied or validated and needs further refinements. With this background, it is of importance to this dissertation to explore the interdisciplinary documentation practice between nurses and physicians to gather knowledge on the applicability of a multi-professional EHR in a Norwegian setting.

2.4 Conclusion

The interdisciplinary approach and interest in information overlap as a topic for this dissertation rests upon knowledge production that unites various methods through a focus on a common subject or problem. Therefore, interdisciplinarians may be seen in complementary relation to one another (Repko, 2008). The rapid adoption of IT by health care organization has an impact on nursing and medicine in numerous ways, challenging, for example, work and communication processes (McBride, 2006). The nursing-medical relationship illuminates core aspects and challenges of interdisciplinary documentation practice when introducing an EHR. This dissertation will contribute to knowledge on interdisciplinary communication processes between nursing and medicine, exploring documentation practices.

The reviewed literature converges on the findings that nurses and physicians are mostly concerned with their own documentation practice in the EHR, and do not discuss interference, integration and information overlap with other health care providers. There is also a discrepancy in scope between nurses and physicians regarding documentation in the literature. The nursing community is not very concerned with the interdisciplinary and technological aspects of documentation in the EHR, although the collaborative articles illustrate a shift towards teamwork and workflow (Davidson et al., 2004; Makary et al., 2006). In medicine, the interest is implications of system failures and systems development that creates inefficiency, is time consuming and non-supportive of physicians' clinical workflow and not the documentation itself (Alvarez & Coiera, 2006; Hronek, 1995; Munkvold et al., 2006). In summary, the perspective of interdisciplinary documentation practice by nurses and physicians is not very well acknowledged in the literature. The documentation practices seem to be intra-professional rather than inter-professional.

About 90 % of the information transactions between health care providers are synchronous communication and question the ability of an EHR to improve interdisciplinary information processes (Coiera et al., 2002; Scott et al., 2007). The lack of "gold standards" in documenting communicative actions in medical decision-making (Bakken, 2006) can explain why these information transactions are mainly synchronous. The findings from the literature show that the EHR does not improve documentation itself, and factors promoting

a safe and improved patient care and ease the work and information flow in the EHR can be summarized as follows:

- An interdisciplinary system interface (Amatayakul, 2009; Coiera, 2007; ISO 215 Technical report, 2003)
- Development of multidisciplinary templates, a shared language and ubiquitous access to the patient record (Bricon-Souf & Newman, 2006; De Clercq, 2008; Keenan & Yakel, 2005)
- Implementation of shared notes between nurses and physicians (Fuller, 2006; Kruger, 2007; McKelvie, 1997)
- Mutual respect and recognition between health care providers (Kenny, 2002; Rafferty et al., 2001; Willis & Parish, 1997)

Factors prohibiting a safe and improved patient care and sufficient interdisciplinary information flow in the EHR are, according to the findings from the literature, as follows:

- Lack of semantic and functional interoperability in the EHR
- A profession based documentation practice where the nurses' documentation practice runs parallel to the physicians' notes
- Professionalism, tradition and practice boundaries

There are also some core issues according to the research questions in this dissertation that do not appear in this selection of the literature. First, the physicians' documentation practice is hardly mentioned in the literature, leaving an impression that this group does not pay much attention to the structure and content of their electronically charted notes. The interdisciplinary communication pattern or system in the EHR is not present in the material, except from a multi-disciplinary problem based documentation model (De Clercq, 2008). Implementation and evaluation of multidisciplinary EHRs is neither found in the literature, nor in studies of design. The literature reveals that interdisciplinary documentation practice remains largely unexplored regarding timeliness, accuracy and efficiency in the current documentation practice by nurses and physicians (Foster et al., 2002; Holmboe & Hawkins, 1998; Martin, 1992; Poissant et al., 2005).

The overall conclusion from the literature is that the interdisciplinary approach to communication and documentation systems improves core aspects of patient care (Adler, Bryk, Cesta, & McEachen, 1998; Cox, 2000; Davidson et al., 2004; Schoop & Wastell, 1999). However, the field is relatively unexplored. Further research is recommended since interdisciplinary information sharing and information flow related to documentation of health care in the EHR is not sufficiently addressed in the literature.

This dissertation's focus on identifying information overlap, common interdisciplinary documentation foci and timeliness (accessibility) of nurses' and physicians' charted notes in the EHR will be one contribution to this end. To do so, a new instrument was developed to explore and capture information overlap in the existing charted notes and summaries by nurses and physicians.

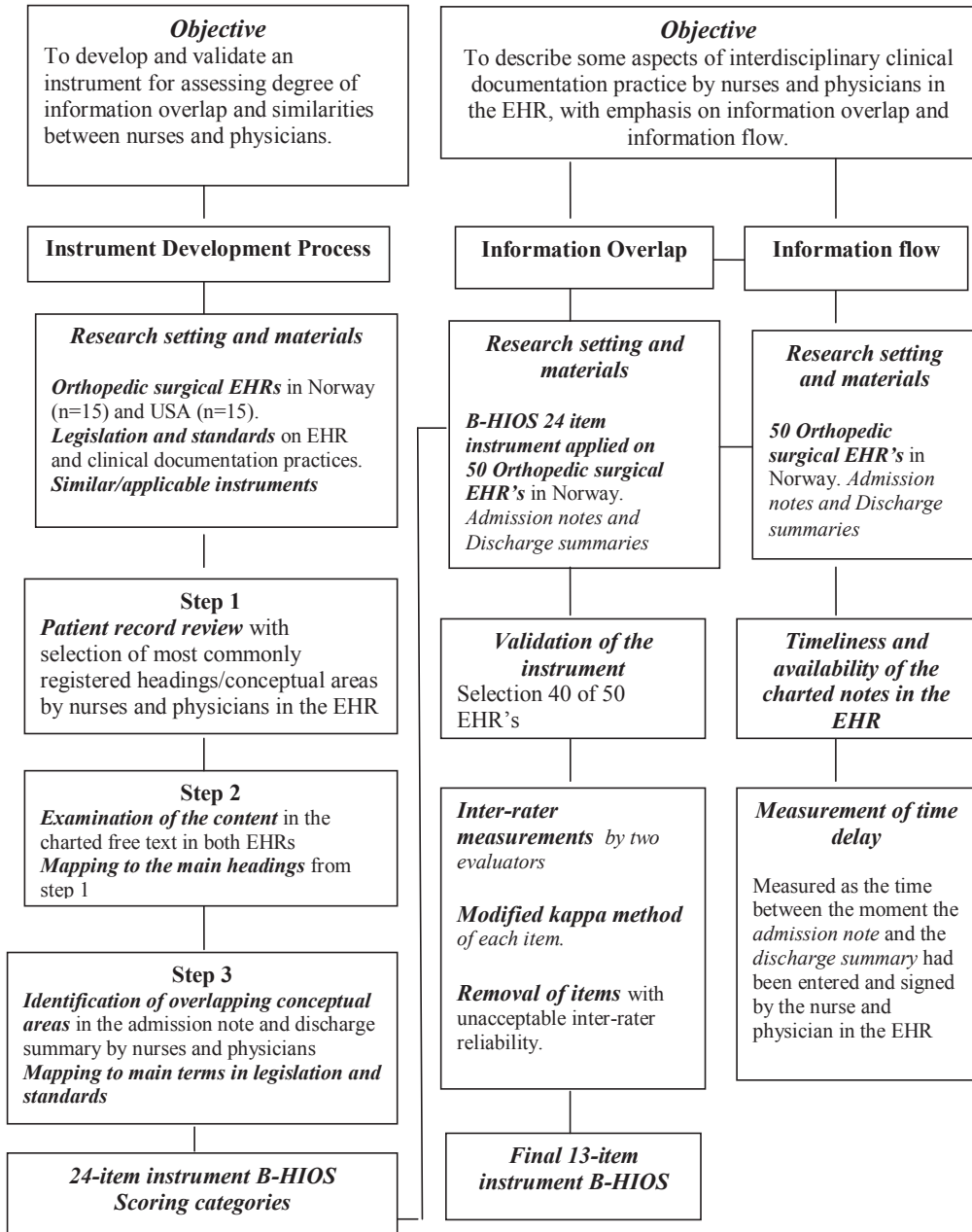
3.0 DESIGN AND METHODS

The four purposes of this chapter are to describe the research methodology of this study (3.1), to explain the sample selection (3.2), to describe the procedure used in designing the instrument and collecting the data (3.3), and to provide an explanation of the statistical procedures used to analyze the data (3.4).

The primary objective of this study was to describe some aspects of interdisciplinary clinical documentation practice by nurses and physicians in the EHR, with emphasis on information overlap and information flow. A secondary objective was to develop and validate an instrument for assessing degree of information overlap and similarities between nurses and physicians.

Section 3.1 in this chapter describes the research design of this study; section 3.2 and 3.3 presents the research setting and materials. Section 3.4 presents the EHR systems at the main study sites. The next section contains a presentation of applicable instruments influencing the choice of methods on item development and scaling (section 3.5). Section 3.6 and 3.7 presents method of collecting data for the instrument development process and how the data was analyzed and validated. In order to assess the question on information flow, the method of collecting data for measurements of time delay is described in section 3.8.

3.1 Research Design



The empirical part of this dissertation has a cross sectional design. Thus, recorded variables are only measured once in each included patient record. This type of design can be thought of as providing a "snapshot" of the frequency and characteristics of one phenomenon in a population at a particular point in time. These studies cannot distinguish between newly occurring and long-established conditions. All they can do is measure the frequency of conditions and demonstrate associations (Bland, 2001; Polit & Beck, 2007).

In instrument development design, the method to obtain data is the main course, where the instrument is a device used to collect data (e.g., a questionnaire, test, observation schedule, etc.). Psychometrics is the field of study concerned with the theory and technique of educational and psychological measurement, which includes the measurement of knowledge, abilities, attitudes and personality traits. The field is primarily concerned with the construction and validation of measurement instruments, such as questionnaires, tests and personality assessments (Slim et al., 2003).

Scaling is commonly defined as to measure; also, to grade or vary according to a scale or system (De Villis, 2003). The scaling procedure is the assignment for objects to numbers according to a rule, and is basically the procedure of getting numbers that can meaningfully be assigned to objects. In this dissertation, a response scale is used to collect the response for a single item in the instrument (Trochim, 2006).

3.2 Research Setting

The research setting for the item identification process in the instrument development included orthopedic EHRs from a university hospital unit from the Veteran Affairs Health Care System (VAHS) in San Diego, USA and from Ulleval University Hospital (UUS) in Oslo, Norway. The department of Veteran Affairs (VA) is responsible for providing federal benefits to veterans and their families. Headed by the Secretary of Veterans Affairs, VAHS is the second largest of the 15 Cabinet Departments in the USA and operates nationwide programs for health care. The whole organization employs about 239 000 health care providers at 1 400 different sites in the USA (Department of Veteran Affairs, 2008). The hospital research setting at the study site was connected to University of California, San

Diego, Health Services Research Unit and to California Institute of Telecommunication and Information Technology (Griswold, Jung, & Bormark, 2006).

The setting at VAHS provides a broad range of inpatient and outpatient health care services, such as medical, surgical, mental health, geriatric, spinal cord injury and advanced rehabilitation services. In 2005, the hospital had 238 hospital beds and 69 skilled nursing home beds. In addition, the hospital had 6 275 acute admissions, extended care of 390 patients, and 560 000 outpatient visits. A total of 4 395 patients had surgery, and approximately 1/3 were in orthopedic surgery (VASDHS, 2006). The exact amount of patients diagnosed with upper hip fracture is not listed in the official overview. Compared to the Norwegian study site the Orthopedic Department was relatively small, but had an extensive outpatient clinic.

The research setting for validation and refinement of the instrument was the orthopedic surgical department in UUS, Norway. The empirical material was drawn from EHRs in 2005. At this hospital approximately 620 000 (2008) patients receives health services annually, and about 9 500 health care providers work there (UUS, 2009b). There were 1200 inpatient beds in 2005, and about 300 000 outpatient visits. The orthopedic department is one of the leading orthopedic environments in Scandinavia in diagnostics, nursing, treatment, and research. Approximately 2 400 trauma patients and 4 500 inpatients are treated at this unit per year (UUS, 2009a). A total of 238 patients were diagnosed with upper hip fractures at the main study site in 2005.

3.3 Materials

The item identification is based on reviews of charted notes in 30 orthopedic EHRs from Norway (15) and USA (15), on findings from the literature review on documentation practice, on documentation models in nursing and medicine (Ehnfors et al., 1998; Karkkainen & Eriksson, 2005; Larimore & Jordan, 1995; Weed, 1975), and from legislation and standards documenting health care in the EHR (HIMSS, 2009; HOD, 2001a; HOD, 2001b; IOM, 2003; KITH, 2004; UUS, 2005). The item identification is also based on developed instruments assessing the quality of documentation practice and information flow in the patient record (Bjorvell, Thorell-Ekstrand, & Wredling, 2000; Charvet-Berard, Chopard, & Perneger, 2008; Moulton, Franck, & Brady, 2004).

The validation of the instrument items and measurements of information flow was carried out at UUS, Norway. This hospital had implemented an EHR from 2004. The measurements were conducted retrospectively, based on admission notes and discharge summaries from 50 surgical orthopedic patient records with the medical diagnosis upper hip fracture in 2005. Two admission notes and two discharge summaries were retrieved from each selected patient record, both from a nurse and a physician. In the same record, one discharge summary, written by a nurse and one by a physician, were retrieved. Four notes were retrieved from one patient record. From a sample of 50 patient records, 200 notes were retrieved and analyzed. The inter-rater reliability measurement was applied to 40 of 50 of the EHRs.

The following criteria were used selecting admission notes and discharge summaries:

- Both nurses and physicians had charted the notes separately in the Norwegian EHR.
- The documentation of patient admission to hospital is crucial for the quality and determination of future patient care.
- The discharge summary summarizes core elements, outcomes and future recommendations of patient care.
- The patients should be in need of treatment and primary care after discharge from hospital.
- Nurses and physicians have written a discharge summary when the patient is transferred to another health care institution or in need of home care.

As earlier accounted for in the literature on the topics documentation (Ehnfors et al., 1998; Weed, 1975) and EHR (Helsetilsynet, 2009; HOD, 2000; KITH, 2001), there are legal and professional standards on the content of the admission note and the discharge summary. Nurses and physicians are obliged to write the admission note when the patient is admitted to the hospital according to local guidelines at the study sites (UUS, 2005; Quillfelt, 2005) and national EHR standards (KITH, 2004; KITH, 2003). The admission note is considered to be the most representative, when compared to other EHR notes, of how and when the nurses and physician document health care (Figure 1, section 3.4.2). Both professionals write the discharge summary (epikrise) in the Norwegian setting. The discharge summaries are defined as letters, because they are sent to one or several receivers outside the hospital (Helsetilsynet, 2009). This implies that the information in the discharge summary is retrieved from existing patient information documented in the EHR. The Norwegian Health Authorities (KITH, 2002; KITH, 2007) has established the following demands on the content of a medical discharge summary:

- Structured resume of patient treatment, procedures and other conditions relevant to the recipient
- Structured information about main diagnosis using ICD-10/ICPC
- Clinical codes procedures (NCSP)
- Medication (historical and present)
- CAVE (allergies)
- Referring diagnosis (code)
- Social background
- History medical diagnosis and treatment
- Actual/present treatment
- Functional level
- Assessment
- Plans follow up

In addition, the physicians may attach patient data, such as description of surgery procedures, results laboratory tests, and procedures (KITH, 2002, p 7 - 8).

Similar legal demands on nursing discharge summaries have been developed in connection to the documentation standardization process in the Norwegian EHR (KITH, 2003). The standard contains the following demands for the nursing discharge summary:

- Patient resources/demands/problem
- Patient aims/expected results
- Interventions
- Evaluation of interventions
- The reason for hospitalization
- Status upon admission
- Status upon discharge

In addition, the nurse may attach patient data to the discharge summary such as CAVE (allergies), patient reservations and wishes, medical diagnosis, information medication, and observations of vital data (KITH, 2003, p 46 - 47).

In order to secure comparability and consistency when validating the instrument, information from orthopedic surgical EHRs with the medical diagnoses, upper hip fractures are reviewed and explored. The patient's diagnosis is not of any interest in this study. The most important reason for selecting this group of patients was to find a homogenous patient group likely to have some predictable health care delivery demands and standards in nursing and medicine.

For each patient the material includes all charted notes from nurses and physicians in the patient record in 2004, from the selected hospitals in USA and Norway. The patient's average age was 78 years. The percentage of the patients living alone in their own home with support from primary health services was 30 %. In 50 % of the patients, the patient was self-dependent, and had a family or partner support, while in 20 % the patients were institutionalized. All patients in the material were in need of rehabilitation and medical follow up. The patient records were from emergency admissions, and all patients included in the material had undergone surgery.

The average patient symptoms and conditions were, according to the EHRs: Pain in the affected hip, bruises in the traumatized area, immobilization and dehydration, or in need of fluid. Malnutrition was observed in some patients during clinical practice, but such information was not easily captured from the charted notes. Measurement of BMI was not present in the Norwegian EHR, while the charted notes in the EHR USA have BMI measurements. Indications of planned treatment were present in both EHR systems.

Based on the assessment of the material and clinical experience with this group of patients, the patients present core issues and challenges in nursing and medicine, especially related to surgery, pain, circulation, nutrition, mobility, and activity. For this group of patients, the health care professionals have made no preparation before admission to the hospital. Therefore, accessibility to initial information entered by the admitting physician to the EHR is crucial for further treatment and care from nurses, surgeons, and anesthetists.

The American Health Information Management Association (AHIMA) recommends implementation of health IT standards for records management to ensure that EHR systems can 1) manage and preserve information and records through its lifecycle, 2) establish minimum metadata requirements for digital record evidence, 3) meet the demands for valid health records and 4) render a complete record of care (AHIMA, 2013; Dougherty M. & Washington, 2010; HL7 EHR, 2013).

The Norwegian Health Act (2001) and North American EHR documentation standards and guidelines for EHR (AHIMA, 2013; IOM, 2003; JCAHO, 2007; Kalra, 2006) does not distinguish between health care professionals regarding content and responsibility demands. Therefore, the conceptual areas derived from the health care legislation pertains to all health care professionals; if health care is provided documentation requirements must be fulfilled.

The following legal conceptual areas have been directly collected from the text in the Norwegian Health Act (HOD, 2001a), chapter 8, from the Regulations of the Patient Record (HOD, 2000), § 8 Content Requirements of the Patient Record, from the Patient Right Act (HOD, 2001b) and from North American Documentation guidelines for EHR in use at the VAHS (IHS, 2010).

Table 7: Conceptual areas derived from Norwegian Legislation and documentation guidelines VAHS

§8 Journalforskriften - Regulations of the Patient Record			
Norwegian full text	*Concepts in English	Guidelines EHR VAHS	Concepts
Tilstrekkelige opplysninger til å kunne identifisere og kontakte pasienten, blant annet pasientens navn, adresse, bostedskommune, fødselsnummer, telefonnummer, sivilstand og yrke.	Identification of relatives/contact persons of the patient	Sufficient information to identify the patient.	Patient administrative data
Journalen skal føres fortløpende. Nedtegnelser skal gjøres uten ugrunnet opphold etter at helsehjelpen er gitt.	Continuous recording of given health care without undue delays	Accurate, prompt recording. Entries must be accurate, relevant, timely and complete	Timely continuous recording
Bakgrunnen for helsehjelpen, opplysninger om pasientens sykehistorie, og opplysninger om pågående behandling	Historic summary of family, social, medical, and nursing care. Background information of previous hospitalization. Concurrent information on medical and nursing care.	Actual medical care.	Medical history Medical and nursing status
Beskrivelse av pasientens tilstand, herunder status ved innleggelse og utskriving	Descriptive patient status at admission and discharge from the hospital		Patient status
Foreløpig diagnose, observasjoner, funn, undersøkelser, diagnose, behandling, pleie og annen oppfølging som settes i verk og resultatet av dette Plan eller avtale om videre oppfølging	Tentative and current medical diagnosis, observations, findings, examinations, diagnosis, treatment and care Results of nursing and medical care Medical and nursing plan (treatment plan) Plan for follow up treatment	Justification diagnoses and treatment. Document results of care or treatment.	Care plan Medical plan Outcomes Follow up
Individuell plan etter spesialisthelsetjenesteloven § 2-5, psykisk helsevernloven § 4-1 eller kommunehelsetjenesteloven § 6-2a	Individual plan – coordination between different levels of health care delivery		Individual plan

§ 45A Health Personell Act: Epikrise (Discharge summary)

Norwegian full text	*Concepts in English	Guidelines EHR VAHS	Concepts
<p>Det skal ved utskrivning fra helseinstitusjon oversendes epikrise til det helsepersonellet som trenger opplysningene for å kunne gi pasienten forsvarlig oppfølging, og til pasientens faste lege.</p> <p>Dersom det ikke er mulig å sende epikrise samtidig med utskrivning, skal epikrise uansett sendes innen forsvarlig tid etter at helsehjelpen er avsluttet.</p>	<p>A discharge summary is written upon discharge from the health institution.</p> <p>Contains necessary information to secure the patient proper treatment and follow up from other health care provider.</p> <p>Must be sent within proper time upon patient discharge, preferably without delays.</p>	<p>Describe the condition upon discharge</p> <p>Document instructions given to the patient, follow-up care, activity, medication</p>	<p>Discharge summary accessible upon discharge from hospital.</p> <p>Patient status Treatment history Follow up Medication</p>

§3 Pasientrettighetsloven - Patient Right Act

Norwegian full text	*Concepts in English	Concepts
<p>Pasient har rett til å medvirke ved gjennomføring av helse- og omsorgstjenester og ved valg mellom tilgjengelige og forsvarlige undersøkelses- og behandlingsmetoder.</p> <p>Tjenestetilbudet skal utformes i samarbeid med pasient og bruker. Det skal legges stor vekt på hva pasienten og brukeren mener.</p> <p>Pasienten skal ha den informasjon som er nødvendig for å få innsikt i sin helsetilstand og innholdet i helsehjelpen.</p> <p>Dersom pasienten samtykker til det eller forholdene tilsier det, skal pasientens nærmeste pårørende ha informasjon om pasientens helsetilstand og den helsehjelp som ytes.</p> <p>Opplysning om den informasjon som er gitt, skal nedtegnes i pasientens journal.</p>	<p>Patient participation in treatment planning and implementation.</p> <p>Patient views and opinion is emphasized.</p> <p>Information given to patient/relatives – including possible risks and bieffects of treatment.</p> <p>The patient is obliged to necessary information achieving insight in own health condition and the content of health care.</p> <p>Mandatory documentation of information given to patient and relatives in the EHR.</p>	<p>Patient and relatives views</p> <p>Documentation given information</p> <p>Necessary information</p> <p>Mandatory documentation of given information</p>

3.4 The EHR Systems at the study sites

The EHR system at the study site in Norway and at the Veteran Affairs Health System (VAHS) in San Diego, USA in 2005 - 2006 was based mainly on proprietary information models (ISO 215 Technical report, 2003). The knowledge of operability and usability of the North American EHR system was obtained during a stay in USA in 2006. The stay was funded by a research scholarship at the University of California San Diego, Veteran Affairs Medical Research Foundation, and USA. Additionally, published sites from VAHS (VASDHS, 2006) and Department of Health (Department of Veteran Affairs, 2008) including VistA home site (VHA office of Information, 2008) were scrutinized.

According to findings in the literature (section 2.4) and own experience, the EHR systems in Norway and USA in 2006, do not support cooperation between different professional groups. The North American EHR system do not accommodate information exchange mediated by shared documents, the system do provide shared documents/notes that are entered by both professions. The charted notes by all health care professionals are stored in a longitudinal manner in the EHR. A major difference between the Norwegian EHR system DLPasDoc and VISTA regarding documentation of health care, is the document structure and usability of the charted notes.

In order to display the real content of the charted notes and how charted notes are structured and displayed in the EHRs from USA and Norway, some examples of written admission notes by nurses and physicians are presented in full text with headings in Appendix 1 and Appendix 2. However, it is of importance to the item identification process, developing a new instrument, to illustrate the documentation practices and predefined headings used in the two EHR systems. Another aspect of presenting the notes from the two EHR systems is to exemplify similarities and differences of the documentation practices in nursing and medicine between USA and Norway. Therefore the following subsections presents the headings (in bold) and the authentic written text from the two EHR's.

3.4.1 Examples of charted Admission notes in the EHR from USA and Norway

Example 1: Vista EHR, USA

Nurses Admission note

Mental status

Alert, Always oriented to person, always oriented to place, always oriented to Time. Understands/Follows instructions, speaks clearly.

Mood: Calm.

Recent medical/surgical history

Refer to note History and Physical examination.

Neurosensory

No neurosensory problem noted, hand grasps equal.

Pain scale of 0-10 taught or reviewed. Verbalizes understanding of pain scale.

Patient's stated: Acceptable Pain Level: 6. Pain is satisfactorily controlled.

PAIN #1 - Location: Both lower extremities. Constant non-radiating pain. Began years ago and continues. Pain severity 6 out of 10. Movement makes pain worse. Analgesia makes pain better. Denies visual problems, hard of hearing left ear, hard of hearing right ear, deny sleep problems.

Initial learning assessment

Able to read, speaks English, no learning barriers or limitations to learnin.

No Areas of Cultural Beliefs/Practices patient would like addressed.

Adequate motivation/readiness to learn, Prefers to learn by hearing.

Patient's understanding of Medical Condition (in patient's own words): *"metal left knee"*

Patient stated expected length of stay is: 5 days. Patient stated length of stay is realistic. Patient's knowledge of medical condition is adequate.

Initial discharge plan

Planned destination upon discharge: Patient's home.

Estimated days until discharge: 6 days.

Patient's Discharge concerns: None.

Patient's Health concerns: None.

Age-related concerns: Middle adult.

Allergies/Medications

No New Allergies, Known Allergies Reviewed, No Allergy to LATEX (rubber).

No Problems with Current Medications. Medications that were brought to the hospital have been sent home. Patient took routine medications today - last taken at: 0430, Medications listed in computer.

Cardiovascular

Cardiac rhythm (via peripheral pulse) is regular. No lower extremity edema noted.

Reproductive

No history of sexually transmitted diseases reported. No male reproductive organ discharge. No history of erectile dysfunction reported.

Musculoskeletal

Weakness of both legs. Examination pulse not displayed.

Respiratory

Not listed.

Nutrition

Denies nutrition problem. Regular diet.

Bowels

Denies bowel problems. Bowel sounds present.

Urinary

Denies urinary problems.

Diabetes

Patient is not diabetic.

Advance directives

Patient does not have an Advance directive and does not want one at this time.

Skin

Patient denies skin problems, warm and dry. Norton Scale: Not listed.

Functional assessment

No balance problem. Independent with ADL's. No problem eating or drinking. No communication problem. No pain with ADL's. Morse Fall Risk Score: Low Risk 15.

Psychosocial

No abuse concerns. No significant Hx of alcohol use. No significant Hx of drug use. No mental health concerns. No Hospitalization/Family problems. No Legal Concerns.

Support systems

Assistance from family members available.

Problems

Pain. Hearing Problem. Musculoskeletal Problem.

Physician Admission H&P**General review**

CHIEF COMPLAINT(s): Knee *pain*

Present illness

64 yrs. Male with left knee DJD. S/P L Knee Arthroscopy/with 2b and 3a changes. Predominant medial/PF Compartments: Pt. c/o pain 6/10, + Nite pain, walking of approx. 100 yds.

Therapies tried

Nsaids, SI with on short-term sx relief, Unloader Brace. His sx improved somewhat with scope, but pain remains sign enough that he wishes to proceed with TKA. Pt. was cleared medically.

1/05 X-Ray: A tiny effusion is again seen. Tricompartmental osteoarthritis, with severe joint space narrowing of the medial compartment, is stable. There is mild joint space narrowing in the patellofemoral compartment on this side.

Current problem list

23 problems classified to ICD-9 (not listed)

Surgeries

Left Knee Scope.

Allergies

Patient has answered NKA.

New Allergies: *None.*

Active Inpatient and Outpatient Medications (including Supplies)

The list is not displayed.

Additional medications: *No.*

Transfusion HX: *None.*

Lives with: *Wife.* Lives on Sailboat.

Substance use/abuse: *Never.*

Occupational history/Toxin Exposure

Probably many chemical/asbestos exposures while working as a Ship Builder.

Family medical history: *None.*

Hypertension: *Not listed.*

Review of systems: *Not listed.*

Physical exam and general appearance

Vital signs: *Not listed.*

Appearance: *Not listed.*

Cardiovascular and Pulmonary: *Not listed.*

Abdomen and musculoskeletal: *Not listed.*

Genitourinary and Neurological: *Not listed*

Psychiatric

Alert and oriented to time, place and person.

The first example from USA (Example 1) elucidates core aspects of contemporary documentation practice by nurses and physicians. In the literature, it is pointed out that lack of integration of information between nurses and physicians on the same patient is problematic (Abraham et al., 2008; Amatayakul, 2005; Hronek, 1995). However, as displayed in this example from USA, nurses' and physicians' charted notes is presented chronologically, as longitudinal progress notes in the same file/document in the EHR. The notes have predefined headings (bold style) and choices with either a box to place a checkmark or text (bold style).

The nurses and physician admission note from the VistA EHR are basically complementary. However, the example shows that there is an overlap in the charted notes of nurses and physicians on basic information like social background and diabetes. The admission note written by the nurse has a narrative style (free text) when describing patient phenomena, and the identification of patient problems are not classified in to i.e. nursing diagnosis.

The writing in the physician note contains an extensive use of abbreviations, and there is less free text compared to the nurses' note (Appendix 1). The physician classifies the patient diagnosis into ICD-9. The notes do not contain dates and time of accessibility in the example, because this was removed before displaying the charted notes to the researcher by the head secretary of the orthopedic department VSAHD. The first note by physician (operative note), however, is processed into the EHR after surgery, which indicates that at least a 12 hours' time delay is present between the nurses and physician admission notes.

The second example is from the Norwegian EHR and shows the charted admission notes from nurse and physician on the same patient (Appendix 2). The charted notes by nurses and physicians are stored separately in the Norwegian EHR.

Example 2: Norwegian EHR

Nurse admission note from the Admission Department

Nursing anamnesis

Reason for contact: Pat. fell today when getting into her car. She says that she started to shiver before she fell.

Actual health- and nursing history

Surg. FCF earl. Surg. Ulcus. Cer. Insult 2 years ago. Osteoporosis.

Social background

Married.

Source of information

Patient and personnel from the ambulance.

Patient status

Communication: Awake, ready and oriented.

Respiration and Circulation: N/A.

Nutrition: Last approx 0800, drank water approx. at 1100.

Elimination: Not asked.

Skin/Tissue: Dry and warm skin. Wound left arm. Left leg shortened and out rotated.

Pain/Sensory condition: Pain in the hip.

Reason for admission: Fasting for surgery

Admission note nurse from the Orthopedic Department

Patient fell today when she was together with her husband. Says she felt unwell before she fell. The couple lives together. No public assistance known. She has had a cer. insult before, has osteoporosis and surg. left hip before.

Patient status

Communication: Awake and adequate. Seems ready and oriented.

Respiration/Circulation: BP: 145/80, P: 97, SaO₂: 96%. Dry and warm skin.

Nutrition: Fasting from 0800. Has only drunk one glass afterwards (at 1100). Progressing 1000 R.A. i.v., and she can moisten her mouth in between with sponge.

Elimination: Urinated a little in the admission department. Says she is continent.

Skin/Tissue: A small scrape on left elbow that is covered. The surgical leg is swollen and out rotated, not marked.

Physician admission note from the ER/Admission Department

Diagnosis

Subtrochant femur fracture left.

Family/Social

Lives with spouse.

Previous diseases

Had surgery stomach ulcer many years ago, probably Billroth II. Has also had medial colli femur fracture primary nailed and screws removed afterwards.

Actual

Fell outdoors today from own height. Trauma left hip. Clinical manifest fracture confirmed by x-ray that shows a subtrochant femur fracture. Hospitalization for surgery.

Natural functions: Problems with urine leakage.

Allergy: Not known.

Fixed medication: Not listed.

Present status at 1500 Hour: 80-year-old woman, in bed on examination. Awake and affected by pain. Good cooperation.

Vital signs: Not listed.

Cor/Pulm/Abdomen/Lower extremity: Not listed.

Resume

80-year-old woman acute admission with a subtrochant femur fracture left. Fasting before surgery and a 6-hole DHS with support plate are planned.

Example 2 illustrates how nurses and physicians document their admission notes in the Norwegian EHR. The headings (bold) are predefined for both professions, but there is little predefined text or boxes for checkmarks in the templates compared to example 1 from USA. The nurses and physicians differ in how they process the information to the EHR. Nurses write the notes directly while physicians dictate and use transcription services. This is also the case in the North American EHR. The charted notes in the Norwegian EHR are also longitudinal, but the notes are stored separately in the EHR. In the Norwegian EHR system, professional belonging determines the accessibility to the patient record, and this is the navigator to the charting process. The nurse has a complete set of different types of notes or documents that only the nurse processes (nursing record), while the physician has a similar separate set of notes or documents (medical record). The notes are not visible or integrated/shared with other health care professionals. The latter phenomenon will be referred to as a profession based and/or parallel documentation practice and represents the opposite of patient centered and/or integrated documentation practice.

The example from the Norwegian EHR illustrates that there are two admission notes by the nurse, one from the admission department, and one from the orthopedic department. The nurse in charge of the patient after transmission to the orthopedic department repeats some of the information on reason for hospitalization and skin/tissue observations documented in the first nursing admission note. There is a discrepancy regarding the patients' social status, the first nurse document that the patient is married, and the second nurse document that the couple lives together. The nurses' note is in a narrative form structured with predefined headings. The writing in the physician note has more abbreviations similar to the physician admission note in example 1, but describes actual status and reason for hospitalization in a narrative form. The information documented by the physician does repeat information already documented by the nurses on social status (married) but describes reason for hospitalization in a different way. This is an example of three different descriptions of the same incident. The physician states in previous diseases that the patient had stomach ulcer and surgery, and does not mention an episode of cerebral insult or the previous diagnose osteoporosis documented by the nurses. This illustrates that the physician probably has not utilized the existing documentation on the patient that has been entered by nurses in the EHR.

3.4.2 Types of notes and document/information flow in the Norwegian EHR

The Norwegian Record is structured into several sub groups. The nurse and physician have separate chapters, but they have more or less the same sub-groups (Ahlfeldt et al., 1999) when documenting health care delivery. The nursing record contains the nursing care plan as a sub-group, while a medical care plan is not present in the physician record (Helsetilsynet, 2009). As an example of relevance to this dissertation, the structure in the Norwegian EHR lacks an interdisciplinary documentation system with shared documents and therefore does not support or provide a common terminology.

In order to clarify the separate structure of the notes in the Norwegian EHR, an overview and comparison of the notes is presented in the next table. The following types of notes are present in the nursing and physician record in the Norwegian EHR as earlier described as sub-groups in the Norwegian Record (Helsetilsynet, 2009).

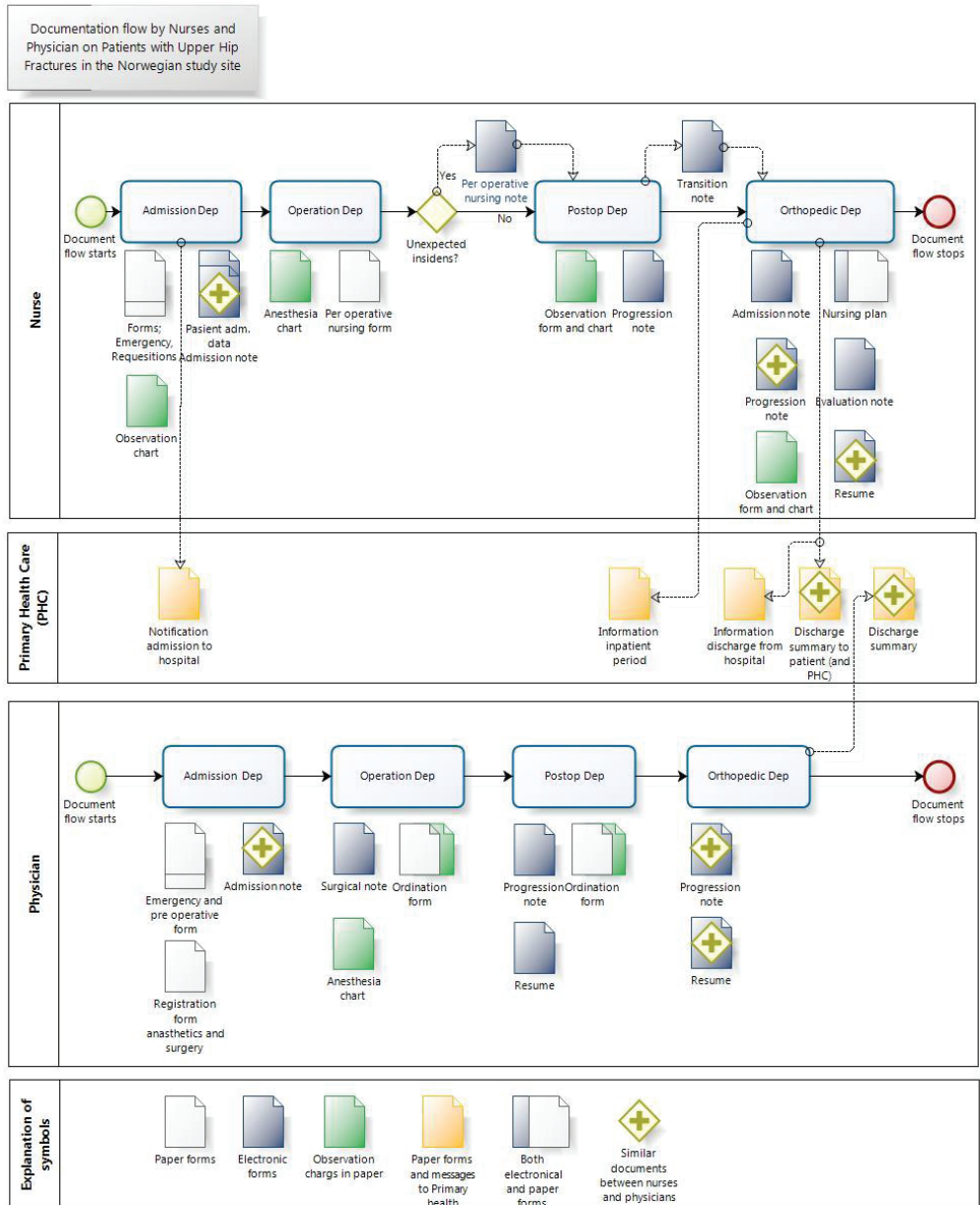
Table 8: Overview of the notes in the nursing and physician record in the EHR

Types of notes		Nursing record (Sykepleiejournal)	Physician record (Legejournal)
English	Norwegian		
Admission record	Innkomstjournal		X
Admission note	Innkomstnotat	X	X
Admission status	Ankomststatus	X	
Progression note	Journalnotat, hendelsesnotat	X	X
Transmission note	Overflyttingsnotat	X	X
Outpatient note	Poliklinisk notat	X	X
Procedure note	Prosedyrenotat		X
Summary	Resymé	X	X
Consultation note	Tilsynsnotat	X	X
Telephone note	Telefonnotat	X	X
Ultrasound note	Ultralydnotat		X
Discharge summary	Utskrivelsesnotat	X	X
Blind note	Blindnotat	X	X
Home visit	Hjemmebesøk	X	
Risk assessment	Risikovurdering	X	

The table demonstrates that nurses and physicians in the Norwegian EHR have common types of notes in their separate records, and that nine of the 15 notes are overlapping. The shared notes are admission note, progression note, transmission note, outpatient note, summary note, consultation note, telephone note, discharge summary and blind note. As displayed in section 3.4, example 1, the documentation system of health care in the North American VistA EHR system is structured so that there is no separation of the medical and nursing record. All notes are processed basically in one document or file labeled *Progress note* in the EHR. All health care providers process their notes in the same document, and the structure is more tasks related than profession related.

The next figure illustrates the information flow in terms of documentation of health care in the course of treatment on patients with upper hip fractures in the Norwegian study site. The flow chart also illustrates to some degree documents/notes/forms and charts that are electronic, paper form or both and the information flow between levels of health care delivery. The flow chart also indicates similar documents between nurses and physician in the course of treatment in the EHR at the main study site.

Figure 1: Information flow chart at the Norwegian study site



It seems to be a common practice in nursing documentation to start the admission note in the admission department and continue the documentation when admitted to the orthopedic department. Two nurses are involved in this documentation process and theoretically represent a continuum of the admission note as stated in the local requirements (UUS, 2005). The physicians, however, dictate their admission note mainly in the Admission Department. According to this information flow chart, the physician has a different documentation practice upon patient admission to hospital than the nurse. This may reflect the difference in scope and professional role compared to the nursing profession, as discussed previously in this chapter.

Clinical work processes can explain the difference in documentation practice. At this stage, upon admission, the physician determines if the patient is in need of surgery and performs different diagnostic procedures and prescriptions of blood tests, ECG, X-rays, fluids etc. The physician dictating the admission note is not necessarily an orthopedic surgeon, and other physicians do not necessarily supply or add more information to the note when the patient is transferred to the orthopedic department.

The flow sheet illustrates that nurses and physicians have documents that has the same labels (admission note, progression note, resume, discharge summary). The information is entered separately to the EHR. The nurses have the overall responsibility coordinating the information flow between different care settings (messages). The flow sheet also illustrates that the clinical documentation by nurses and physicians regarding given treatment and care is mainly electronic. However, the main ordination forms and observation charts are paper based.

3.5 Developed Instruments

The literature review showed that researchers have not yet developed instruments that measure information overlap between nurses' and physicians' charted notes in the EHR. The initial main article search, in particular from the PubMed database, resulted in many different psychometric scales as for example; Quality of Life (QOL, SF 36®) (IQOLA, 2009), Eating Disorders Quality of Life Scale (EDQLS), Multidimensional Assessment of Pain Scale (MAPS) (Ramelet, Rees, McDonald, Bulsara, & Abu-Saad, 2007) and The Clinical Information System Implementation Evaluation Scale (CISIES) (Gugerty, Maranda, & Rook, 2006). However, psychometric scales for capturing degree of interdisciplinary overlap and content in the patient record were not found in the literature.

Two developed instruments; 1) CAT-CH-ING (Bjorvell et al., 2000) and 2) EQIP (Moult et al., 2004) were obtained from the literature. The first instrument was developed to measure the quality of nursing documentation in the patient record. The second instrument was developed to assess quality of written patient teaching information. These instruments were selected because of the item identification methods and to exemplify the nature of an audit instrument, in particular the scaling development process. The development process of the two audit instruments has not only influenced the methodology of the instrument development in this dissertation, but has been essential to the item identification process.

Instrument 1: Cat-ch-Ing

The CAT-CH-ING audit instrument was developed to assess nursing documentation based on the VIPS-model (Ehnfors et al., 1998; Ehrenberg, Ehnfors, & Thorell-Ekstrand, 1997). The instrument has been tested and recommended in several studies in Scandinavia (Darmer et al., 2006; Leth et al., 2005; Nilsson & Willman, 2000). The audit instrument was developed by determining specific criteria to be met. The criteria for determination of item identification (questions) are derived from the following sources: Swedish law, The VIPS-model (professional) and from common hospital policies and review of 60 patient records. The audit questions were aimed at revealing the content of the patient for nursing assessment, nursing diagnosis, planned interventions, and outcome. The three auditors

reviewed each of the 60 records independently and calculating the inter-rater reliability coefficient tested the reliability of the instrument. The CAT-CH-ING instrument consists of 17 questions (items): 10 items reflecting assessment of the step of the nursing process, four administrative questions (signature, dating and legibility), one concerning VIPS keywords, and one about the information about the nurse in charge of the patient. Both quantity and quality variables are judged on a rating scale from zero (indicating poor) to three (indicating very good). The maximum score possible in an audit is 80. The authors concluded that the instrument had proved to be valid for measuring information pertinent to the nursing process, and that it possesses a high degree of inter-rater reliability. However, the VIPS-model must be implemented in the nursing documentation system before application of the instrument, and CAT-CH-ING is not applicable without this criterion. This limits the applicability to other nursing documentation models, and in particular to interdisciplinary documentation models, e.g. in a multidisciplinary documentation setting, and when the common SOAP model in medicine and nursing is applied.

The future modalities of documentation will shift from a nursing centered (professional based) to a patient centered context of an integrated health care system (Darmer et al., 2006). In spite of the lack of interdisciplinary approach, the instrument development process is highly relevant to this dissertation because the item identification is based on legislation, literature review, review of patient records and professional standards and models in nursing documentation.

Instrument 2: EQIP-scale

The Ensuring Quality Information for Patients (Charvet-Berard et al., 2008; Moult et al., 2004) tool was developed to assess quality of written patient teaching information. The EQIP-scale is applicable to all information types, and to prescribe the action that is required following evaluation. The first objective was to develop a practical measure of the presentation quality for all types of written health care information. The second objective was to provide preliminary validity and reliability of the measure in a pediatric setting. The development of EQIP consisted of a three-step procedure:

PHASE 1

Key themes were extracted from a comprehensive qualitative literature review using different databases with specific search terms, along with a hand search of relevant books and grey literature. The authors limited the measurement tool to the following criteria: completeness, appearance, understandability, and usefulness. The process resulted in 20 criteria. The criteria were transformed to questions to be answered “yes” or “no” with a four-level scoring algorithm. A purposive sample of nine individuals evaluated five randomly selected health care information leaflets to establish usability. A “partly” option was added to the scoring algorithm after the evaluation. The scoring formula was revised and enabled more weight to “yes” answers than “partly” answers. To enable managers to take actions according to the quality score, five actions statements were developed.

PHASE 2

The revised EQIP tool was pilot-tested for concurrent and criterion related validity to determine if the measurement tool was able to distinguish between information of poor and high quality, and correlated to other measures of information quality. Inter-rater reliability by experts of the quality of information and the actions required for each of the leaflets. The sample was 33% of the total numbers of leaflets published by the hospital in 2000 (85 leaflets). The result of the testing demonstrated adequate correlation between two measures and strong agreement between the expert raters.

PHASE 3

The final stage evaluated the inter-rater reliability and utility of the measurement tool annually in a period of three years. The measurement tool achieved a high degree of agreement between the pairs of raters. EQIP demonstrated reasonable reliability and validity over time with large samples of diverse leaflets from one hospital.

The authors have a few limitations regarding usage and generalization of the measurement tool. The instrument was constructed in the context of UK regulations and standards, and they do not refer to any international standards or studies of significance. However, the authors point out that further reliability and validity testing on written health care information for other settings and population is needed, for example on the web.

The EQIP instrument has further on been revised and expanded (Charvet-Berard et al., 2008). The aim of the revision project was to 1) expand EQIP with criteria derived from a literature review, 2) restructure the expanded tool to the three dimensions of content, structure and identification data, and 3) use the new tool to assess the quality of information documents in a large university hospital. The instrument was applied to another international setting and population. The process ended up with additional 16 items from the review to a total of 36 items. The revised instrument tool was named EQIP36.

The development process of the EQIP instrument, in particular the scaling development process, is highly applicable to the instrument development in this dissertation. In particular, the three-step procedure with item identification, scoring rates, and testing contributes to the understanding of the methodology of developing an instrument.

3.6 Instrument Development Process

In the conclusion of the literature review (section 2.4), the following four factors promoting a safe and improved patient care and information flow in the EHR were identified:

- An interdisciplinary system interface.
- Development of multidisciplinary templates, a shared language, and ubiquitous access to the patient record.
- Implementation of shared notes between nurses and physicians.
- Mutual respect and recognition between health care providers.

The input to the development process came from four sources:

- Patient record reviews, representing accumulated experiences and local practice.
- Legal requirements, representing an external position of expectations from society.
- Professional standards, representing an internal position of collective practice
- Developed instruments for extracting and evaluating information from patient records, representing relevant methodological scientific approaches to measure information overlap.

These factors guided the process of developing the instrument to explore the documentation practices of nurses and physicians in the EHR.

Step 1: Patient record review

In order to assess the issue of interdisciplinary information overlap, it was necessary to select conceptual areas/items that *most commonly are registered by the nurses and physicians* in the EHR, i.e. pain and medical diagnosis. The main challenge in the development process was to identify these items. Therefore, a patient record review was performed on 30 orthopedic surgical EHRs in Norway and USA. To gather knowledge on legislation and standards related to recording health care was also part of the groundwork in the instrument development process as well as knowledge on methods of item identification and scaling from the developed instruments Cat-ch-Ing and EQIP scale (section 3.5).

Step 2: Examination of the content in the charted free text

The second step of the item identification process focused on establishing the content validity and authenticity of the instrument, including a content examination of all the charted *free text* in the two EHR systems. The text was mapped to the main headings retrieved in step 1 with ranked frequency of the conceptual areas. The most frequent conceptual areas were then listed. The inclusion criterion for most frequent conceptual areas was set to a range from 16 to 30 times. Frequency rate below 16 times was not included. Then a manual audit and extraction of *headings* from the admission notes and discharge summaries was performed. Only headings (later labeled instrument items) used as default in the admission note and discharge summaries were extracted at this point as displayed in example 1 and 2 (section 3.4).

Step 3: Identification of overlapping conceptual areas

The third and final step aimed at identifying common conceptual areas in the admission note and discharge summary between nurses and physicians. The overlapping conceptual areas were mapped to the main terms used in the legal and professional standards. To establish a common term and secure that legal requirements were taken into consideration, the overlapping conceptual areas were mapped to the main terms identified from the Norwegian Health legislation and the documentation guidelines in the EHR from VAHS, USA (table 8). In addition, the overlapping conceptual areas were mapped to professional documentation standards (tables 3, 4 and 5).

Scoring categories

The scoring categories were constructed in a way that made it possible to retrieve not only overlapping conceptual areas between nurses and physicians, but also to retrieve information that only the nurses or physicians document. The system of scoring categories makes it possible to explore specific conceptual areas that are within the scope of one profession, as well as areas that are not documented by one profession, or not documented at

all by nurses and physicians. The scores were chosen on a nominal level, with the following five categories:

1. Only physician: The conceptual area is present only in the physician note.
2. Only nurse: The conceptual area is present only in the nurse note.
3. None: The conceptual area is not present in the nurse or physician note.
4. Both: The conceptual area in question is present in both the nurse and physician note.
5. Not applicable: The conceptual area in question is not relevant or not existing for the patient.

The score categories are based on whether or not the conceptual area is present in the charted notes. The score category “only physician” is used when only the physician has documented, for example the concept area *previous medical diagnosis* in the admission note, and not presented in the nursing admission note. The score categories “only physician”, “only nurse” and “none” represents no overlap, but shows particular professional scopes and conceptual areas that are present or not in the documentation. However, these scores indicate professional diversity in scope and assessment of the patient treatment and care. When the score category “none” is present, core aspects of patient care are not documented. In the following, conceptual areas are referred to as items of the instrument. The items are based on legal and professional demands in documentation of health care and lack of documentation within these items are considered insufficient documentation practice. The instrument does not only capture content overlap between nurses and physicians, it also captures specific professional concerns related to the identified items. These items are probably equally important to the overlapping items, and can potentially enhance the usability of the instrument. The score category “both” indicates that both the nurse and physicians have documented for example pain in their notes.

3.7 Validation Procedure

This section describes the approach to establishing inter-rater reliability of the instrument, and how a modified kappa method was developed and applied to the 24-item instrument.

Cohen's Kappa was used as a measure for inter-rater reliability for potential items in the instrument. Cohen's Kappa can only be used when two raters used the same response categories. This limitation of Cohen's Kappa was removed by developing a modified version of Cohen's Kappa.

The inter-rater reliability measurement was applied to 40 of 50 Norwegian EHRs from 2005 in the main material in this study (section 3.1.1). The reduction from 50 to 40 took place by removing first two patient records for every section of ten from the material. The inter-rater measurement of the scores was conducted on the remaining 40 audited records, independently rated by the researcher and an expert nurse from the clinical field. The raters had the same professional and academic background, and both raters had performed independent inquiries of the documentation practice in the EHR in earlier research studies.

Validation of the instrument in this dissertation was based on the convention that reliability and validity relates to each other, and in the context of critical realism actually form a continuum (Cook & Campbell, 1979), as earlier accounted for in the introduction to this chapter (3.0). Reliability has to do with the stability and precision of the measurements, and a measure is considered reliable if it would give the same result when repeated on the same object (Polit & Beck, 2007). Results regarding reliability of the instrument are presented in section 4.2.

Validity refers to whether the instrument measures what it is intended to measure (Cook & Campbell, 1979; Lund, 2005). When validating an instrument or a scale based on several items, it is common in the medical literature to estimate internal and external validity. However, estimation of internal validity, by calculating Cronborgs alpha (Altman, 1991; Polit & Beck, 2007), requires that the items intend to measure the same phenomena. This is not the case for the items in the developed instrument measuring information overlap.

Further, external validation of an instrument or a scale requires access to previous instruments aiming at measuring information overlap, which to the best of my knowledge do not exist. Thus, external validation of the present instrument is not possible.

The inter-rater agreement of the instrument was measured using the kappa method to analyze nominal data ($n=40$), items 1 - 24. The kappa statistic can be interpreted as: *the chance-corrected proportional agreement* (Altman, 1991). Kappa measures to what extent results obtained by two or more raters agree for similar or the same population. Kappa is applicable as a measure of raters' agreement for an item if less than 80 % of the responses on the item are equal for both raters, and that none of the response scores are used only by one of the observers. Kappa has a maximum value of 1.00 when agreement is perfect, a value of zero indicates no agreement better than chance, and negative values shows worse than chance agreement (Altman, 1991). To guide interpretations of kappa (K) values between 0 and 1, Fleiss (1981) and Altman (1991) suggests the following guidelines:

Table 9: Guidelines- strength of agreement values of K

Values of K Fleiss	Values of K Altman	Strength of agreement
< 0.40	<0.20	Poor
0.40 – 0.59	0.21 – 0.40	Fair
0.60 – 0.74	0.41 – 0.60	Moderate
	0.61 – 0.80	Good
0.75 – 1.00	0.81 – 1.00	Very good/excellent

According to the table, they suggest that a kappa moderate strength of agreement value is within the range of 0.41 – 0.74. The mean value of K between Fleiss and Altman in this table is 0.58. Thus, in this study, a kappa between raters of more than 0.40 is considered acceptable. The kappa coefficient is sometimes not possible to calculate, because kappa evaluation requires *variation* in the variable's score (Altman, 1991). In these cases % equal scores kappa is used to express inter-rater score value. A rater agreement of at least 65 % is considered to indicate acceptable reliability in this study.

When trying to calculate kappa on the original individual items in the instrument, it turned out that kappa was not measurable for the majority of the items. On this background, it was

considered necessary to modify the items before further kappa calculations were made. When kappa could not be calculated for an item, the following procedure was used:

- *If a rater uses a score alternative that is not used by the other rater, and both raters use at least two different scores, a modified item is made.*
- *The scores used by both raters for this item are selected.*
- *The most prevalent score is denoted as '1', and the other scores are denoted as '2'.*
- *The original kappa is calculated on this modified item.*

This modification served to maximize the possibility of calculating kappa. This procedure is denoted as 'the modified kappa' method². The following example illustrates the procedure: Suppose that one rater uses the scores 1, 2, 3, 4 and 5 for a variable, while the other rater uses the scores 1, 2, 3 and 4. Then calculation of kappa is not possible because lack of variation and the above-described procedure to modify is used. Thus, the scores 1, 2, 3 and 4 are selected. Suppose that score 3 is the most prevalent in this selection. Then we make a new variable where 3 is coded as 1, and the scores 1, 2, 4 and 5 are coded as 2. Finally, the original kappa equation is used to calculate kappa values of this new variable. Modification of items enabled kappa estimation of inter-rater reliability in most of the cases, where the original kappa could not be calculated. The intention was to develop a modification procedure, which makes sense from a clinical point of view, and still relies on the philosophy behind the original kappa calculations. On this background the modified kappa method is considered appropriate for measuring inter-rater agreement in this instrument.

The raters used the coding manual as described in table 14 and 15 in section 3.1.4 and entered data directly in SPSS. The instrument after measuring the inter-rater reliability consists of 13 items (conceptual areas), seven items in the admission note, and six items in the discharge summary. The instrument was named B-HIOS (Bormark Health Information Scale).

² In cooperation with professor Leiv Sandvik, Oslo University Hospital, Norway

3.8 Information Flow and Accessibility of Charted Notes

The third research question assesses information flow challenges: How large is the time delay between accessibility of nursing and physician documentation of patient care in the EHR? The information flow challenges, in terms of documentation, relate to timeliness and availability of the written admission notes and discharge summaries for collaborating nurses and physicians. Measures of the actual time delay between the charted notes in the EHR express how the information is available for decisions on treatment and follow-up of future care of the patient.

The availability of the charted notes is measured by calculating time delay. Measures of the actual time delay between the charted notes in the EHR express how the information is available for decisions on treatment and follow-up of future care of the patient. When comparing time delay between nurses and physicians as regards to admission notes and discharge summaries, 95 % Confidence Intervals for the differences were calculated. These intervals are based on the paired T-test statistics, and may be used to decide whether these differences are statistically significant. The measurement of time delay was performed to the same material from the instrument development process (50 Norwegian EHRs).

The charted notes in the EHR are not accessible or valid to other health care providers before they are signed electronically. However, the notes may be read from the moment the text has been entered in the EHR, but the status will be shown as “not valid”. The time upon signature is displayed in the EHR, as well as the point of time when a patient is admitted or discharged from the hospital. Time was measured as the time between the moment the admission note and the discharge summary had been entered and signed by the nurse in the EHR, and the moment the note from the physician had been signed and validated in the EHR.

Time was measured closest to the whole hour by 30 minutes. The time setting in the EHR is by hour and minutes upon signature. If the time was 14:40, the real time was set to 15:00. The material was then split into percentiles to display the distribution according to time delay. The confidence interval (CI) was calculated in the admission note and discharge summary to measure the probability that the time delay between the nurses and physician note could be caused by chance. The significance level was set to 0.5, indicating “the

probability that a relationship of the observed magnitude would be found by chance only 5 times out of 100” (Polit & Beck, 2007, p 766). The results of measuring time delay are presented in chapter 5.0.

3.9 Ethical Considerations

The empirical data/material of interest in this dissertation is retrieved from electronically stored data in the EHR. The director of the Orthopedic Department and the Hospital Research Department at the main study site in Norway regarded this study as a contribution to the quality assessment research area (Appendix 2). Since retrieving data on documentation of health care in patient records does not involve human subjects directly, this study did not require approval by The Regional Board of Ethics (HOD, 2006).

The input to the development process of the instrument comes partially from reviews of patient records in North America, in addition to the Norwegian EHRs. Accessibility to the North American EHRs was obtained through the Human Research Protections Program, IRB (Institutional Review Board) approval in the USA (Appendix 3). The Department of Health and Human Services in USA has empowered IRBs to approve, require modifications in planned research prior to approval, or disapprove research. The IRB performs critical oversight functions for research conducted on human subjects, which are *scientific*, *ethical*, and *regulatory* (National Institutes of Health, 2007).

However, the data contents identity information of the patient and the health care professionals, which can lead to identity disclosure in the process of analysis. In order to avoid disclosure of the identity of health care professionals and patients, the data was copied from the EHR to paper. All names or identification indicators were removed from the data and stored in a local research server in Norway.

Summary Design and Methods

The review of the literature did not reveal any instrument that measures information overlap between nurses and physicians in the EHR. However, procedures regarding development of an instrument were present, and methods of three step item identification and scaling procedures were applied in the instrument development. Another important groundwork for the instrument development process was patient record reviews, legislation and professional standards. Findings from the literature points out that an important tool to achieve documentation improvement is by developing multidisciplinary templates and a shared language, and that further research is recommended on interdisciplinary communication and the content of the documentation.

To answer the research questions in this dissertation an instrument was developed to explore information overlap between nurses and physicians' admission notes and discharge summaries in the Norwegian EHR. A method for measuring information flow in terms of time delay was also developed.

The instrument development process was divided into a three-step procedure as follows:

- A patient record review on 30 orthopedic surgical EHRs from Norway and USA with an overview of national and international legal requirements, professional standards, and similar instruments. Selection of most commonly registered headings
- Examination of the content in the charted free text in both EHR's with mapping to main headings from step 1
- Identification of overlapping conceptual areas with mapping to main terms in legislation and standards

An amount of 24 items were identified from this procedure, 11 items in the admission note and 13 items in the discharge summary. The outcome of the item identification process reflects the professional scopes and content in the charted admission notes and discharge summaries by nurses and physicians. The admission note is characterized by medical history, cause of admission, status and treatment upon admission to hospital, while the discharge summary is characterized by an overall picture and summary of patient treatment,

nursing care and future recommendations upon hospital discharge. The items reflect core professional aspects and diversities between nursing and medicine.

When validating an instrument it is common to estimate internal and external validity. In this case, estimation of internal and external validity is not possible. The reason for this is that the items do not measure the same phenomena, and instruments measuring information overlap has not been developed. The inter-rater reliability measurement was applied to 40 of 50 Norwegian EHRs. In order to enable measurement of the inter-rater reliability in the material, a modified kappa method was developed, which measured 21 of 24 items. This modification served to maximize the possibility of calculating kappa. This procedure is denoted as 'the modified kappa' method. A kappa between raters of more than 0.40 was considered acceptable, or a rater agreement of at least 65 % was considered to have acceptable reliability. The instrument after measuring the inter-rater reliability consists of 13 items (conceptual areas), seven items in the admission note, and six items in the discharge summary. The instrument was named B-HIOS (Bormark Health Information Scale).

The primary objective in this study, apart from describing information overlap, was to describe information flow in terms of time delay. The time delay was measured as the time between the moment the admission note and discharge summary had been entered and signed by the nurse in the EHR, and the moment the note from the physician had been signed and validated in the EHR. The material was split into percentiles to display the distribution according to time delay. The confidence interval (CI) was calculated.

4.0 INSTRUMENT DEVELOPMENT AND VALIDATION

This chapter presents the results from the instrument development process and validation. The first section 4.1 presents characteristics of the sample followed by section 4.2 presenting the results from the three step item identification process. Section 4.3 displays the outcomes of the inter-rater reliability measurement. The final instrument after validation is presented in section 4.4.

4.1 Characteristics of the Sample

The total number of patients diagnosed with upper hip fractures and underwent surgery, classified as ICD10 S720; at the main study site in 2005 was 238. The gender distribution was 72 % women and 28 % men. Mean age was 83 years. Among these patients, 93 were not discharged to a health institution, home care, or to a rehabilitation program since 76 patients died (not connected to surgery), and 17 patients were discharged from the hospital to their private homes. EHRs from these 93 patients did not contain summary or discharge summaries from nurses, and were not included in the study. Thus, the total number of patient records with documentation meeting the inclusion criteria decreased to 145.

An amount of 50 EHRs were selected using stratified sampling. Stratification is the process of dividing members of the population into subgroups before sampling. In this case, the 145 patient records were divided into subgroups by the month the patient was admitted to the hospital. The subgroups were sampled as follows: The first four patient records were sampled for each month (48 patient records) and two patient records were added from the end of the month of December.

The gender distribution of the 50 selected patient records was 74 % women and 26 % men. Mean age was 81 years. The mean inpatient period was 16 days with a range from 1 – 31 days. Thus the 50 selected patient records are representative compared to the total sample of patient records as regards age and gender.

4.2 The three step item identification process

Step 1: Patient record review

The documentation in the admission notes and discharge summaries was structured with predefined headings in both EHR systems. In this setting, a heading is a conceptual area. Eventually the conceptual area represents an instrument item. The headings were listed and then compared and synthesized between the two systems into common headings. Table 10 displays the synthesis of the manual retrieval of headings from nurses' and physicians' admission note and discharge summaries in the EHRs from Norway and USA, as exemplified in section 3.3, example 1 and 2.

Table 10: Summary of headings (bold style) and subgroup headings

ADMISSION NOTE	
NURSES	PHYSICIANS
Nursing anamnesis	Diagnosis
Contact and cause of events	Admitting physician
Health and nursing history	Record note written by
Current nursing	Physician in charge of patient
Social background	Family/Socially/Ethnicity/Heredity
General information	Previous diseases
Source of information	Current situation
Various information	Natural functions
Patientstatus:	Stimulant
Communication/Knowledge/Development/ Respiration/Circulation/Nutrition/Elimination/Skin/ Tissue/ Activity/Sleep/Pain/Sensory condition/ Psychosocial/Spiritual/Cultural/Well-being	Allergies
	Medication
	Present status:
	Height/Weight/HR/BP/ Temperature/Pupil/Cave/ores/Collum/Thorax/ Pulmones/Cor/Abdomen/ Rectal exploration/Lower limbs/ Additional examinations
Follow-up	Resume and assessment
10 Headings/Conceptual areas	13 Headings/Conceptual areas

DISCHARGE SUMMARY	
NURSES	PHYSICIANS
Cause of admission Resume treatment and progress Patient status: Communication/Knowledge/ Development/Respiration/Cirkulation/Nutrition/Eli mination/Skin/Tissue/ Activity/Sleep/Pain/Sensory condition Psychological/Spiritual/Cultural/Well- being Recommendations interventions Appointments 5 Headings/Conceptual areas	Diagnosis/Procedures Primary physician Previous diseases Current situation/Course of admission Status (free text summary) Additional examinations Further process and treatment Medication upon discharge from hospital Follow up 9 Headings/Conceptual areas

An amount of 23 headings from the admission note and 14 headings from the discharge summary were obtained from step 1. The table shows that the headings vary more in the admission note than in the discharge summary between nurses and physicians. In addition, the physicians have more headings. The templates with headings reflect the core aspects of documenting health care. The headings are the guidelines for documenting health care by nurses and physicians. Table 10 displays that the major concern in nursing is the overall social, physical and psychological consequences of illness and treatment, while the major concern in medicine is diagnostic procedures and medical interventions/treatment. This finding is in accordance with core elements from the professional characteristics as described in section 2.2. The finding also reflects professional documentation standards from the SOAP (table 3) and VIPS model (table 4), and the health care elements from the multi-professional problem-based conceptual model (table 6).

Step 2: Examination of the content in the charted free text

The retrieval of headings/conceptual areas in step 1 was followed by reading the free text charted by nurses and physicians in the EHR that was written in other notes/documents, i.e. progress notes and transmission notes. This is the text that follows the predefined headings in the EHR systems. However, the results are presented within the framework of conceptual

areas identified in step 1. The content of the free text was registered manually to appropriate identified conceptual areas. The ranking was based on the frequency of a conceptual area, i.e. how often a conceptual area is present in the documentation. In this process, the following redundant headings were removed: *Admitting physician*, *Record note written by*, and *Primary physician* (heading in both the admission note and the discharge summary). A total of 3 headings were removed from the admission note by the physicians, and 1 heading from the discharge summary by the physician. This was necessary because of the disclosure of identity of the health care provider, which is not relevant in the present study. A ranked frequency of the conceptual areas was performed on the sample of 15 Norwegian and 15 North American EHRs (30), as shown in table 11:

Table 11: Conceptual areas of the free text, ranked by frequency

N=30 EHRs			
ADMISSION NOTE			
NURSE	Frequency	PHYSICIAN	Frequency
General information	30	Diagnosis	30
Patient status	30	Medication	30
Contact and course of events	20	Present status	30
Various information	20	Resume and assessment	30
Source of information	19	Previous diseases	28
Health and nursing history	18	Natural functions	28
Social background	15	Family, Social, Ethnicity, Heredity	25
Follow up	10	Current situation	20
Current nursing	8	Stimulantia	20
Nursing anamnesis	0	Allergies	15
10 Headings/Conceptual areas		10 Headings/Conceptual areas	
DISCHARGE SUMMARY			
NURSE	Frequency	PHYSICIAN	Frequency
Course of admission	30	Diagnosis and procedures	30
Appointments	29	Current situation/Course of admission	30
Patient status	25	Medication upon discharge from hospital	30
Resume treatment and Progress	13	Status	28
Recommendations Interventions	5	Previous diseases	20
		Follow up	25
		Further process and Treatment	16

		Additional examinations	10
5 Headings/Conceptual areas		8 Headings/Conceptual areas	

The following headings/conceptual areas did not meet the inclusion criterion: *Resume treatment and Progress*, *Recommendations interventions* and *Additional examinations*. The findings of most frequent conceptual areas from the review of the free text were then mapped into the previous identified conceptual areas, respectively in the nurses and physicians admission notes and discharge summaries, as exemplified in table 12:

Table 12: Most frequent Conceptual areas (frequency at least 16)

ADMISSION NOTE	
NURSES	PHYSICIANS
Contact and course of events	Diagnosis
Health and nursing history	Family/Socially/Ethnicity/Heredit
Social background	Previous diseases
General information	Current situation
Source of information	Natural functions
Various information	Stimulantia
Patient status	Medication
	Present status
	Resume and assessment
7 Conceptual areas	9 Conceptual areas
DISCHARGE SUMMARY	
NURSES	PHYSICIANS
Course of admission	Diagnosis/Procedures
Resume treatment and progress	Current situation/Course of admission
Patient status	Status (free text summary)
Recommendations interventions	Further process and treatment
Appointments	Medication upon discharge from hospital
	Follow up
5 Conceptual areas	6 Conceptual areas

An amount of 27 headings was obtained from step 2. The procedure in this step strengthens the validity of the conceptual areas by also including concepts from the free text in the nurses and physicians notes and mapping them to previous identified conceptual areas in the EHR. The data was retrieved from current EHRs and reflect actual documentation practice

by nurses and physicians. This means that the most frequent conceptual areas reflect core areas of documentation practice in this sample of orthopedic surgical patients.

The procedure resulted in a reduction of headings from 37 to 27 conceptual areas. The result demonstrates less difference between nurses' and physicians' topics, as reflected in the headings.

In table 13 below, the provided example sheds light on the use of different terminologies of the same phenomena between nurses and physicians. The example was derived from an authentic Norwegian EHR.

Table 13: A patient case illustrating content overlap between nurses and physicians

Patient record # 27		ADMISSION NOTE	
NURSE		PHYSICIAN	
Heading		Heading	
<i>Health and nursing history</i>		<i>Previous diseases</i>	
<p>Inpatient Psychiatric ward in approximately one week, should be transferred to "...” but admitted to hospital because of a fracture. According to the nurse, who does not know the patient very well, the patient has not been able to walk alone for the last 2 days. Complained about pain in the left leg. No one has seen her fall.</p>		<p>No information about past somatic illness, the patient denies answering questions of previous disease. She is currently an inpatient at the Psychiatric ward, planned transferred to "...” Nurse at the psychiatric ward says that the patient was admitted because of an acute delusion rather than a severe psychiatric condition. The patient has strong pain from the left hip and is referred to orthopedic department.</p>	

The example elucidates that the nurse and the physician may document the same patient information in different headings, and the headings are misleading regarding the actual content of the note. The information on pain and psychiatric ward is present in both notes, but also information on the patient status regarding pain, localization, and functionality is

documented. However, the nurse documents the patients' expression of pain, while the physician is more precise documenting localization and strength of the pain.

Step 3: Identification of overlapping conceptual areas

The last step in the item identification process was to identify the overlapping conceptual areas between nurses and physicians, within the admission note and discharge summary. The extracted headings from both EHRs was compared and synthesized to common conceptual areas. These conceptual areas are the fundament in the development process representing common headings used by nurses and physicians in the admission note and discharge summary. The results of this process are displayed in table 14:

Table 14: Common conceptual areas between nurses and physicians

ADMISSION NOTE		
NURSES	PHYSICIANS	COMMON CONCEPTUAL AREAS/ITEMS
Contact and course of events Health and nursing history Social background	Diagnosis Previous diseases Current situation	Medical diagnosis Previous medical diagnosis Current treatment
General information	Medication	
Patient status Source of information	Present status Family/Socially/Ethnicity/Hereditiy Natural functions Stimulantia	Medication Patient status
Various information	Resume and assessment	Pain Medical treatment plan
DISCHARGE SUMMARY		
NURSES	PHYSICIANS	COMMON CONCEPTUAL AREAS/ITEMS
Course of admission Resume treatment and progress	Diagnosis/Procedures Current situation/Course of admission	Medical diagnosis Historical medical diagnosis Medical treatment inpatient period
Patient status	Medication upon discharge from hospital Status (free text summary)	Medication Patient status
Recommendations interventions Appointments	Further process and treatment Follow up	Follow up

To establish a common term and secure that legal requirements are taken into consideration, the overlapping conceptual areas were mapped to the main terms identified from the Norwegian Health legislation and the documentation guidelines in the EHR from VAHS, USA (table 8). In addition, the overlapping conceptual areas were mapped to professional documentation standards (table 3 and 4). This resulted in the following additional conceptual areas/items in the admission note: *Patient expressions*, *Relative(s) expressions*, *Discharge planning* and *Care plan*. In the discharge summary the following conceptual areas/items was added to the instrument: *Outcome pain*, *medical treatment*, and *nursing care*. *Follow up medication*, *activity* and *nutrition*. An amount of 24 items were identified from the mapping of overlapping areas, 11 items in the admission note and 13 items in the discharge summary.

The instrument was named Bormark Health Information Scale – B-HIOS.

The 24-item B-HIOS Instrument with score categories and description

B-HIOS Admission Note (11 items)			
Items	Score categories		Description
Medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	The current main medical diagnosis and/or tentative/cause of admission.
Previous medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Previous/history medical diagnosis, not current diagnosis.
Current treatment	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current procedures conducted in the admission department. Procedures described when applicable.
Medication	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Previous and/or current medication
Patient status	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current situation is described, vital signs and measurements when applicable, X-rays, MR, equipment, blood samples Psychological, social, and emotional observations and signs.
Pain	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Localization and patient expressions/judgments are described.
Patient expressions	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Patients own verbal expressions are described. Not applicable when patient is unconscious
Relative(s) expressions	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	The expressions of the relative(s) described, their opinions have been taken into consideration. Not applicable when relatives are not present.
Discharge planning	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Discharge planning is described with contact information to other health care institutions and/or other health care professionals. Not applicable when patient admitted directly to OR.
Medical treatment plan	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Referrals/link to medical procedures and description of an estimated pathway during hospitalization
Care plan	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Referrals/link to nursing plan/care plan/nursing interventions.

B-HIOS Discharge Summary (13 items)			
Items	Score categories		Description
Medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current medical/surgery diagnosis.
Historical medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Summary of previous medical diagnosis if applicable.
Medical treatment inpatient period	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Summary of medical treatment/care during the inpatient period.
Historical summary medical treatment	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Summary of previous medical treatment and care. Not applicable when patient do not have any previous hospitalization.
Medication	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	All actual medication in use. Not applicable when patient do not use any medication.
Patient status	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current patient situation described.
Outcome pain	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Pain related statements that are subjectively and/or objectively described. Results of pain treatment and pain management.
Outcome medical treatment	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Results of surgery and other medical procedures.
Outcome nursing care	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Summary of results referring to nursing plan and/or nursing diagnosis, interventions and observations.
Follow up medication	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Observations, doses, end-time medication, suggestions for further pharmaceutical approach, and demands. Not applicable when no medication is prescribed.
Follow up activity	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Activity plan, prescription, procedures. Referrals/links. Time estimation.
Follow up nutrition	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Nutrition plan, observations, patient preferences, recommendations. Not applicable if there are no nutrition issues/problems identified.
Follow up appointments	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Future appointments, planned appointments.

4.3 Validation of the Instrument

Cohen's Kappa was used as a measure for inter-rater reliability for potential items in the B-HIOS instrument. Cohen's Kappa can only be used when two raters used the same response categories. This limitation of Cohen's Kappa was removed by developing a modified version of Cohen's Kappa.

Table 15: Results inter-rater reliability on Admission Notes and Discharge Summaries

N=40 EHRs	#	ITEMS	MODIFIED KAPPA	% EQUAL SCORES	ACCEPTABLE RELIABILITY
ADMISSION NOTE	1	Medical diagnosis	0.24	78	Yes
	2	Previous medical diagnosis	0.40	80	Yes
	3	Current treatment	0.15	45	No
	4	Medication	0.38	80	Yes
	5	Patient status	n. a.	98	Yes
	6	Pain	0.47	80	Yes
	7	Patient expressions	0.18	23	No
	8	Relative(s) expressions	0.39	78	Yes
	9	Discharge planning	0.07	45	No
	10	Medical treatment plan	0.40	65	Yes
	11	Care plan	0.12	55	No
DISCHARGE SUMMARY	12	Medical diagnosis	n. a.	98	Yes
	13	Historical medical diagnosis	0.35	78	Yes
	14	Medical treatment inpatient period	0.11	65	No
	15	Historical summary medical treatment	0.17	43	No
	16	Medication	1.0	100	Yes
	17	Patient status	0.11	73	No
	18	Outcome pain	0.58	83	Yes
	19	Outcome medical treatment	n. a.	53	No
	20	Outcome nursing care	0.03	13	No
	21	Follow up medication	0.13	38	No
	22	Follow up activity	0.38	88	Yes
	23	Follow up nutrition	0.06	63	No
	24	Follow up appointments	0.68	83	Yes

Table 15 shows that 13 of 24 items had acceptable inter-rater reliability. Four items in the admission note and seven items in the discharge note did not meet the criteria of acceptable inter-rater reliability. The four items in the admission note were: *current treatment*, *patient expressions*, *discharge planning* and *care plan*. In the discharge note, the seven items were: *medical treatment inpatient period*, *historical summary medical treatment*, *patient status*, *outcome medical treatment*, *outcome nursing care*, *follow up medication* and *follow up nutrition*.

Based on these results, the number of items in the instrument was reduced from 24 to 13, seven items in the admission note, and six items in the discharge summary.

The final average value of the modified kappa estimation is 0.47, meaning a moderate strength of value, and an average of 84 % for the equal scores in the final instrument.

Table 16: The final Instrument after inter-rater reliability measurement

N=40 EHRs	#	ITEMS	MODIFIED KAPPA	% EQUAL SCORES	ACCEPTABLE RELIABILITY
ADMISSION NOTE	1	Medical diagnosis	0.24	78	Yes
	2	Previous medical diagnosis	0.40	80	Yes
	3	Medication	0.38	80	Yes
	4	Patient status	*n.a.	98	Yes
	5	Pain	0.47	80	Yes
	6	Relative(s) expressions	0.39	78	Yes
	7	Medical treatment plan	0.40	65	Yes
DISCHARGE SUMMARY	8	Medical diagnosis	*n.a.	98	Yes
	9	Historical medical diagnosis	0.35	78	Yes
	10	Medication	1.0	100	Yes
	11	Outcome pain	0.58	83	Yes
	12	Follow up activity	0.38	88	Yes
	13	Follow up appointments	0.68	83	Yes

*n.a: not applicable

The Final 13 item B-HIOS Instrument

B-HIOS Admission Note (7 items)			
Items	Score categories		Description
Medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	The current main medical diagnosis and/or tentative/cause of admission.
Previous medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Previous/history medical diagnosis, not current diagnosis.
Medication	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Previous and/or current medication
Patient status	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current situation is described, vital signs and measurements when applicable, X-rays, MR, equipment, blood samples Psychological, social, and emotional observations and signs.
Pain	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Localization and patient expressions/judgments are described.
Relative(s) expressions	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	The expressions of the relative(s) described, their opinions have been taken into consideration. Not applicable when relatives are not present.
Medical treatment plan	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Referrals/link to medical procedures and description of an estimated pathway during hospitalization

B-HIOS Discharge Summary (6 items)			
Items	Score categories		Description
Medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Current medical/surgery diagnosis.
Historical medical diagnosis	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Summary of previous medical diagnosis if applicable.
Medication	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	All actual medication in use. Not applicable when patient do not use any medication.
Outcome pain	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Pain related statements that are subjectively and/or objectively described. Results of pain treatment and pain management.
Follow up activity	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Activity plan, prescription, procedures. Referrals/links. Time estimation.
Follow up appointments	1. Only physician 2. Only nurse 3. None	4. Both 5. Not applicable	Future appointments, planned appointments.

5.0 INFORMATION OVERLAP AND FLOW

This chapter presents the results from measuring information overlap and documentation similarities between nurses and physician using the 24-item B-HIOS instrument. Secondly the results of measuring information flow in terms of time delay is presented.

The results on information overlap are presented in section 5.1 for the admission note (5.1.1) and discharge summary (5.1.2). The results on measuring the information flow in terms of time delay is presented in section 5.2 on admission note (5.2.1) and discharge summary (5.2.2).

5.1 Information Overlap

The results from measurements of information overlap between nurses and physicians are presented in two tables, one for the admission note (table 17) and one for the discharge summary (table 18). The items in B-HIOS represent identified conceptual areas in the documentation practice (section 3.0), and the scores are based on whether or not the conceptual area is present in the charted notes and summaries. The results are presented for each score category in the admission note and the discharge summary (section 4.2.1).

5.1.1 Admission Note

The following table displays the results from using the B-HIOS instrument on the charted admission notes by nurses and physicians.

Table 17: Results measurement of information overlap in the Admission Note

ADMISSION NOTE		SCORE CATEGORY									
#	N=50 EHRS Conceptual areas/ B-HIOS items	Both		Only Physician		Only Nurse		None		Not Applicable	
		(n)	%	(n)	%	(n)	%	(n)	%	(n)	%
1	Medical diagnosis	38	76	9	18	1	2	2	4	0	0
2	Previous medical diagnosis	37	74	10	20	2	4	1	2	0	0
3	Medication	1	2	45	90	0	0	2	4	2	4
4	Patient status	49	98	0	0	1	2	0	0	0	0
5	Pain	34	68	0	0	15	30	1	2	0	0
6	Relative(s) expressions	5	10	3	6	3	6	3	6	36	72
7	Medical treatment plan	19	38	28	56	0	0	2	4	1	2

To determine and establish the degree of information overlap between nurses and physicians in the admission notes and discharge summaries, scores in “both” are categorized as 1) Major overlap (> 60 %), 2) Moderate overlap (10 – 60 %) and 3) Not overlap (<10 %).

Results on score category “both”

The results in table 17 show that four of seven items in the admission note have a major overlap between nurses and physicians. The items are: *patient status* (98 %), *medical diagnosis* (76 %), *previous medical diagnosis* (74 %) and *pain* (68 %). A moderate overlap is present in the item *medical treatment plan* (38 %). The remaining two items are not considered to be overlapping: *medication* and *relatives’ expressions*. As displayed in table 17, only five out of 50 EHRs contain documentation on *relatives’ expression* in nurses and physician notes, and one patient record contains overlap in the item *medication*.

In summary, the following items in the admission note have a major overlap between nurses and physicians: *medical diagnosis*, *previous medical diagnosis*, *patient status*, and *pain*, the item *medical treatment plan* have a moderate overlap, and *five of seven* items demonstrate an overlap between nurses and physicians in the admission note.

Result on score categories “only physician” and “only nurse”

The results from these score categories provide an overview of which items that specifically relate to nursing or medicine. By adding the amount of patient records in the score category “both”, respectively to the nurses or physician scores, the actual amount of patient records containing the item in question is revealed for each health care professional.

The score values in the categories “only physician” and “only nurse” reflects the number of patient records where only the physician, or only the nurse, is the contributor to the item. Thus, in these items there is no overlap between nurses and physicians in the admission note. The score results also reflect the scope of medical and nursing documentation practice, in particular items that have the highest score value in table 17.

The results in table 17 show that in the category “only physician”, the physicians preferably document the items *medication* (90 %) and *medical treatment plan* (56 %). In the following two of the seven items in the admission note, the scores on the category “only physician” is zero: *patient status* and *pain*. The items most frequently documented by the physicians are, when results in the category “both” is added: *patient status* (98%), *medical diagnosis* (94 %), *previous medical diagnosis* (94 %), *medication* (92 %) and *medical treatment plan* (84 %).

As displayed in table 17, the results on the category “only nurse” show that the item *pain* is preferably documented by nurses (30 %). Two items have the score rate zero in the category “only nurse”: *medication* and *plan medical treatment*. When the score value “both” is added, nurses most frequently document the conceptual areas *patient status* (100 %), *pain* (98 %), *medical diagnosis* and *previous medical diagnosis* (78 %). In summary, the most prominent conceptual areas documented preferably by physicians are *medication* and *medical treatment plan*. Nurses preferably document the conceptual area *pain*.

Results on score category “none”

The results in table 17 display that there are few EHRs where the items is not documented at all by the nurses or/and the physician. The item *patient status* is always accounted for, and in 6 % of the EHRs, the item *relatives expressions* is not documented. In 4 % of the EHRs the items *medical diagnosis*, *medication* and *medical treatment plan* is not documented. In

only 2 % of the EHRs there are no documentation on the items *previous medical diagnosis* and *pain*.

Results score category “not applicable”

The results in table 17 show that two EHRs are not applicable regarding the item *medication*. This is due to the fact that the patients did not have any medication prescribed or in use upon admission to hospital. In 36 EHRs the item *relatives' expressions* do not contain any information. This is because there were no relatives accompanying the patients upon admission. The score in one patient record on the item *medical treatment plan* are due to an immediate transfer of the patient to another hospital from the admission department.

5.1.2 Discharge Summary

The following table shows the results from using the B-HIOS instrument on the charted discharge summaries by nurses and physicians.

Table 18: Results measurement on information overlap in the discharge summary

DISCHARGE SUMMARIES		SCORE CATEGORIES									
#	N=50 EHRs Conceptual areas/ B-HIOS items	Both		Only Physician		Only Nurse		None		Not Applicable	
		(n)	%	(n)	%	(n)	%	(n)	%	(n)	%
1	Medical diagnosis	49	98	1	2	0	0	0	0	0	0
2	Historical medical diagnosis	17	34	28	56	1	2	4	8	0	0
3	Medication	45	90	3	6	2	4	0	0	0	0
4	Outcome pain	9	18	0	0	40	80	1	2	0	0
5	Follow up activity	39	78	0	0	11	22	0	0	0	0
6	Follow up appointments	33	66	13	26	3	6	0	0	1	2

Results score category “both”

Table 18 illustrates that the following items in the discharge summary have a major overlap between nurses and physicians: *medical diagnosis* (98 %), *medication* (90 %), *follow up activity* (78 %) and *follow up appointments* (66 %). The majority of the conceptual areas (four of six) overlap substantially in this material. The items *outcome pain* (18 %) and *historical medical diagnosis* (34 %) has a moderate overlap between nurses and physicians (between 10 – 60 %).

In summary, the following items in the discharge summary have a major overlap between nurses and physicians: *medical diagnosis*, *medication*, *follow up activity* and *follow up appointments*. The conceptual areas *outcome pain* and *historical medical diagnosis* have a moderate overlap. *All items* in the discharge summary are considered to be overlapping between nurses and physicians in the discharge summary.

Results score categories “only physician” and “only nurse”

As earlier described in the presentation of results on the admission note, the score results in each category reflect the amount of EHRs where only the nurse or physician is documenting within one conceptual area/item. By adding the amount of EHRs from the scores for each item in “only physician” and “only nurse” to the scores in “both” the actual and real amount of EHRs, which contain the conceptual area in question, are disclosed for each health care professional.

The results in table 18 shows that the physicians preferably document the items *historical medical diagnosis* (56 %) and to some degree *follow up appointments* (26 %). Two items have the score value zero in the category “only physician”: *outcome pain and follow up activity*. When the number of EHRs in the score category “both” is added to the score category “only physician”, the following items are most frequently documented by the physicians: *medical diagnosis* (100 %), *medication, follow up appointments* (92 %), *follow up medication* (92 %), *historical medical diagnosis* (90 %) and *follow up activity* (78 %).

The results in table 18 shows that the nurses preferably document the items *outcome pain* (80 %) and to some degree *follow up activity* (22 %). The item *medical diagnosis* has the score value zero in the category “only nurse”. When the results from the score category “both” is added, the nurses most frequently document the items: *Follow up activity* (100 %), *medical diagnosis* (98 %), *outcome pain* (98 %) and *follow up appointments* (72 %). In summary, the most important items in the sample that are preferably documented only by physicians in the discharge summary are: *historical medical diagnosis* and *follow up medication*. In the charting by nurses in the discharge summary, nurses preferably document the following two areas: *outcome pain* and *follow up pain*.

Results on score category “none”

The results in table 20 show that only two items have some lack of documentation in this sample. In 8 % of the EHRs, the item *historical medical diagnosis* was not documented, while in only 2 % of the cases (one EHR) the conceptual area *outcome pain* was not documented.

Results score category “not applicable”

The results in table 18 show that in one of the EHRs the conceptual area *follow up appointments* is not applicable due to immediate transfer of the patient to another hospital.

5.2 Information Flow and Time Delay

This section presents the results of the measurements of time delay. This includes estimating the time delay between the accessibility of the nurse and physician admission note and discharge summary in the EHR. The results are presented in tables for the admission note and the discharge summary. The tables also present percentiles of the time delay.

5.2.1 Admission Note

Table 19: Time Delay in hours between physician and nurse in the Admission Note with percentiles

N=50 EHRs	Mean	95 % Confidence Interval (CI)	Min	Max	SD	Percentiles Time Delay	
Admission Note Time delay	4,8	3,4 – 6,2	-4.0	27,2	4,6	25	2,7
						50	4,1
						75	5,9

The results displayed in table 19 shows that the admission note written by nurses is accessible in the EHR 4.8 hours (mean) earlier compared to the admission notes from the physicians. This difference in mean value is significantly different from zero (95 % CI: 3,4 – 6,2). Time delay was above 5.9 hours in 25% of the admission notes, and was below 2.7 hours in 25%. Thus time delay was markedly increased in 25% of the admission notes.

The next table displays the actual time delay between the accessibility of the nurse and physician discharge summary in the EHR. The charted summaries are not accessible and valid to other health care providers before they are signed in the EHR. The procedure for time measurement is the same as for the admission note. The table also includes a measurement of percentiles of the time delay.

5.2.1 Discharge Summary

Table 20: Time delay in hours between physician and nurse and in the Discharge Summary with percentiles.

N=50 EHRs	Mean	95 % Confidence Interval (CI)	Min	Max	SD	Percentiles Time Delay	
Discharge Summary Time Delay	9,0	1,5 – 19,5	-25,2	191,0	35	25	-1,0
						50	0,6
						75	15,6

The result from table 20 demonstrates a time delay between the nurses and physician discharge summary of nine hours (mean). This mean is significantly different from zero (95 % CI: 1,5 - 19,5). The discharge summary written by the nurse is on average accessible in the EHR nine hours earlier than the physician discharge summary. Time delay was above 15,6 hours in 25 % of the discharge notes a, and was below –1,0 hours in 25 %. Thus, time delay was markedly increased in 25 % of the discharge notes.

6.0 DISCUSSION

The focus of this dissertation is to assess clinical documentation practice in the EHR in order to contribute to an interdisciplinary documentation practice in the EHR that is patient-centered, safe, timely, efficient and equitable.

The primary objective was to describe some aspects of interdisciplinary clinical documentation practice by nurses and physicians in the EHR, with emphasis on information overlap and information flow. A secondary objective was to develop and validate an instrument for assessing degree of information overlap and documentation similarities between nurses and physicians.

The present dissertation has explored the following three research questions:

- 1) To what degree is there information overlap between nurses and physicians in documentation of patient care in the EHR?
- 2) In documentation of patient care in the EHR: Which information items between nurses and physicians are common?
- 3) How large is the time delay between accessibility of nursing and physician documentation of patient care in the EHR?

The discussion seeks to synthesize and discuss the findings from the instrument development process and the measurements of information overlap and time delay in the context of other studies outlined in the literature (section 2.0).

To start with, the discussion will focus on the instrument development process in regards to the challenges of creating a new instrument and refinement. In particular the item identification process and the justification of made decisions are discussed.

Further on, the discussion will focus on the findings from measurements of information overlap; degree of overlap between nurses and physicians in the charted notes and common

information items in the EHR. Finally, the degree of time delay between accessibility of the nursing and physician charted notes are assessed and discussed.

6.1 Instrument Development process and Validation

The review of the literature on previous research and instruments did not reveal any instrument exploring information overlap between nurses' and physicians' documentation in the EHR.

The new instrument, B-HIOS, was developed and the inter-rater reliability was calculated on 40 of the 50 EHRs included in the main material. The refinement of the instrument revealed that four items in the admission note and seven items in the discharge summary did not meet the criteria of acceptable inter-rater reliability. After validation, the average value of the modified kappa was 0.47, interpreted as moderate strength, and average agreement was 84 % in the final B-HIOS instrument.

The following subsection elaborates the results of the modified kappa method and implication of the item reduction on validation issues. These elaborations will be presented separately for the items in the admission note and the discharge summary, beginning with items removed and items where there is acceptable inter-rater reliability.

6.1.1 Items in the Admission Note

The following four of 11 items were removed from the instrument for admission note because of low inter-rater reliability: *current treatment*, *patient expressions*, *discharge planning* and *care plan*. One possible reason why the items *current treatment* and *patient expressions* have a low inter-rater reliability is that the description of current treatment may be difficult to capture in the charted admission note. The information is often described under the heading *patient status* in the admission note or even charted elsewhere in the EHR, like the observation form or chart (Figure 1: Information flow sheet, section 3.4.2). Discharge planning can also be documented elsewhere in the EHR, most commonly in the nurses' daily notes. The item *patient expressions*, however, is often present in the admission note, but the message is often hidden in the text as an observational issue, and not as a

statement from the patient. This may explain the low inter-rater agreement of this item. The items *discharge planning* and *care plan* were not expected to appear in the admission note according to legal and local professional standards (KITH, 2004; UUS, 2005), and is therefore not consistent with local documentation practice. The low reliability indicate that the information in the care plan is not integrated in the admission note or discharge summary. However, there is no electronic link or information exchange between the admission note and the care plan or indication of a discharge plan. Thus, the items may not be considered relevant and valid, which may explain the low reliability of these items. The B-HIOS instrument does accordingly not capture the items *care plan* and *discharge planning* and is consequently not relevant when measuring information overlap in the admission note.

The outcome from the instrument development process supports earlier studies indicating that nurses do not use the problem solving process or a care plan to access initial patient requirements of care (Bjorvell et al., 2003; Ehrenberg et al., 2001; Stokke & Kalfoss, 1999). In both the nurses' and physicians' admission note and discharge summary, the terms closest to a plan concept or the problem solving assessment are patient status, follow-up and recommendations interventions practice. The topics used by the physicians reflect the procedure of medical examination, admission and discharge status, and the medical treatment (Ahlfeldt et al., 1999). However, the physicians use the terms status, further process and treatment, and follow-up. Similar to the nurses' documentation there is no link to, or integration in, a care/treatment plan. Although an integration of a plan is not required in the admission note, according to the professional and legal standards (HOD, 2001a; SykIT, 2000; UUS, 2005), further recommendations and assessment should be linked to a forthcoming plan. In the discharge summary, the plan is a natural part of the summary of medical treatment and nursing care (Ebert & Bethel, 1996; McCloskey, 1975; Moen, Helleso, Quivey, & Berge, 2002; Weed, 1975).

However, the lack of any links or integration of an overall patient plan/discharge planning indicates that the transition from a paper-based to a computer-based documentation tool has not led to a change in documentation practice (Boldregini & Larrabee, 2000). Physicians have traditionally not documented using a plan or followed a problem-based approach to patient care in the progress notes (Afantenos et al., 2005; Branger & Duisterhout, 1991; Weed, 1975), but in nursing, however, the problem based nursing plan is considered the

main documentation tool of health care delivery and the very essence of nursing practice (Henderson, 1982; Lee, 2005; Sahlstedt et al., 1997).

In the following remaining items in the admission note, there is overlap between nurses and physicians: *medical diagnosis*, *previous medical diagnosis*, *patient status*, *pain* and *medical treatment plan*. These items represent common areas that nurses and physicians are documenting. The items have an acceptable inter-rater reliability. The only item in the admission note that does not have a significant overlap is *relative(s)' expressions*. However, the amount of patient record scores in the category “not applicable” is high (36 patient records). The remaining of the patient records is distributed equally between nurses and physicians, and only few patient records are in the category “no one”. This shows that the item is not only relevant, but indeed a part of the documentation practice by nurses and physicians at the study site, and is captured, if applicable, by B-HIOS.

6.1.2 Items in the Discharge Summary

In the discharge summary the following 7 of 13 items did not have an acceptable inter-rater reliability, and were consequently removed from the B-HIOS instrument: *medical treatment*, *historical summary medical treatment*, *patient status*, *outcome medical treatment*, *outcome nursing care*, *follow up medication* and *follow up nutrition*. The items *medical treatment* and *historical summary medical treatment* were difficult to separate during the review of the charted notes and have probably a major content overlap. These items were also found elsewhere in the patient record and were often referred to as attachments in the discharge summary, or charted in a previous summary note, particularly by physicians.

The item *patient status* is not present in the local template and headings of the physicians' discharge summary, although found in the admission note, and were consequently not easy to capture in the written text. However, the nurses' discharge summary has a heading with *patient status*, but the information may also be present in the free text section of the progress notes or in headings, such as *final summary*. This may explain why one rater scores “none” and the other scores “both” on this item.

The items *outcome medical treatment* and *outcome nursing care* were preferably found in the nursing care and/or medical plan (if created), and then attached to the discharge summary. However, the initial review of the EHRs, in the instrument development process, revealed that the plan was often not attached, due to lack of existence or usability in the EHR. Because the plan was created and stored in paper, or not created at all, the documented patient outcomes become a random incidence in the EHR. In the discharge summary by nurses and physicians, national standards and local guideline specify that the provision of a summary of the outcomes of nursing and medical care is mandatory (KITH, 2001; KITH, 2002; UUS, 2005). The planning of the discharge process starts upon admission to the hospital, and is particularly important for groups of patients requiring follow-up rehabilitation. In this study the mean age of the patients diagnosed with upper hip fracture was 81.3 years and the mean inpatient period was 15.6 days (section 4.1).

The low inter-rater agreement of these seven items reveals that without proper templates with headings in the charted notes and a nursing care and/or medical plan, information and measurement of patient outcomes are difficult to retrieve from the patient record. The items *medical* and *nursing outcomes* are relevant in the documentation practice according to legal and professional demands (Ehnfors & Smedby, 1993; HOD, 2000; HOD, 2001b), but at the main study site, the results show that the items were not reliable when B-HIOS was applied to the discharge summaries.

The low reliability regarding the items *follow up medication* and *follow up nutrition* may be explained by the fact that these items were mentioned in the patient status, and as such misinterpreted. For example, one rater took the attachment of prescribed medications in the nursing discharge summary into consideration, coding the item *follow-up medication*, while the other rater did not. These results demonstrate that the used headings are not consistent with the content of the charted note, and that the items are not precise and exclusive enough to enable the raters to capture this information.

An issue of importance is whether an extensive reduction of items influences and decreases the overall reliability and validity of the B-HIOS instrument. As earlier stated in section 3.7, reliability and validity are related to each other. Reliability has to do with the precision of the instrument, the consistency of the measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subject

(Polit & Beck, 2007). Based on this definition, the instrument will be statistically strengthened by the reduction of items if the modified kappa calculations have an acceptable inter-rater reliability.

The validity of an instrument concerns whether it measures what it is intended to measure, indicating the strength of our conclusions, inferences or propositions (Cook & Campbell, 1979). The validity of B-HIOS is probably influenced by the reduction of items. Although an instrument is not valid itself, it is of importance to emphasize the aspect of the construct itself, versus how the construct was developed (Altman, 1991; Polit & Beck, 2007). A relevant question to ask is if the items in the B-HIOS instrument actually measure what they are supposed to measure. In this case, to what extent does the B-HIOS capture information overlap between nurses and physicians in the EHR? Is the amount of items vital to the interpretation of inferences?

The instrument item identification process represents the construct development. In this case, the context and knowledge claim or inferences come from current documentation practice by nurses and physicians in the EHR, and the state of the art derived from the literature including legal and professional standards. The items included in B-HIOS appear to be representative of core areas in contemporary documentation of health care to surgical orthopedic patients. An item reduction will decrease the ability of the instrument to capture documentation practice on some of the core areas. The findings indicate that future measurements of these items are unreliable. However, the face validity of these items seem to be sufficient because of the construct development, and the items in B-HIOS “looks like” it is going to measure what it is supposed to measure (Polit & Beck, 2007). Therefore, future use of the B-HIOS should consider applying the full 24-item instrument on EHRs to capture core areas of nurses and physicians documentation practice.

Notably, the aim of the B-HIOS instrument is to capture information overlap between nurses and physicians, and in that case, the item reduction does not lead to a decreased validity, because it does not influence the construct of the instrument.

6.2 Information Overlap

The following items in the admission note have a major overlap between nurses and physicians: *medical diagnosis, previous medical diagnosis, patient status, and pain*, the item *medical treatment plan* have a moderate overlap, and *five of seven* items demonstrate an overlap between nurses and physicians in the admission note.

The following items in the discharge summary have a major overlap between nurses and physicians: *medical diagnosis, medication, follow up activity and follow up appointments*. The conceptual areas *outcome pain* and *historical medical diagnosis* have a moderate overlap. *All items* in the discharge summary are considered to be overlapping between nurses and physicians in the discharge summary.

The findings from using the B-HIOS instrument to assess information overlap between nurses and physicians will be discussed against results from the score categories in table 18 (admission note) and table 19 (discharge summary) presented in section 5.0. In addition to elaborating on the information overlap, the discussion will point out common interdisciplinary documentation foci and structures. Thus, the discussion will focus on results from all score categories in the B-HIOS instrument to shed light on which conceptual areas are specifically documented by nurses or physicians. This can contribute to understand difference in professional scopes between nursing and medicine, as demonstrated in their documentation practice.

As shown in the section 5.0, the documented overlap of patient information in the recording of nurses and physicians reflect current conventions for documentation in the EHR. The identified overlapping areas represent common information areas and documentation foci by nurses and physicians. In the admission note, the overlapping conceptual areas in the nurses and physicians documents show the two professions' documentation scope and a shared focus on items including *previous medical diagnosis, the patient status upon admission*, as well as descriptions and assessment of *pain*. In the discharge summary the scope and shared focus were *medical diagnosis, medication, follow up activity and appointments*

According to the findings, nurses' and physicians' documentation have a substantial information overlap. The same information is recorded in two separate parts of the EHR; in

the nursing record and in the medical (physician) record (Helsetilsynet, 2009). Such information overlaps are, according to the literature, time consuming, inefficient, and a potential threat to patient safety (Abraham et al., 2008; Afantenos et al., 2005; IOM, 2003), and may increase risks of information flaws and errors. The risk of errors are mainly related to entering and retrieving information, communication, and coordination of health care delivery using information available in the EHR as a resource (Dykes & Bakken, 2004). When the information is stored and entered separately, the risk of different conclusions regarding patient care between health care providers is present. The patient information is not presented in common views in the same way a clinical portal solution would allow for (Kuvås, 2010).

Another aspect of information overlap is related to different processes of entering the information to the patient record, and available services or methods of transcription that presumably lead to information delays in terms of when the information is available to nurses and physicians. Nurses often document using standardized forms or care plans, while physicians rarely use standardized templates to write their clinical notes. Given the number of external requirements (e.g., legal, accreditation), documentation is typically done to support the interests of others rather than patients. Moreover, studies of documentation practices indicate that nurses rarely use the patient record to communicate and make decisions about care, and instead rely on a variety of shadow record-keeping strategies (e.g., scraps of paper, unit forms, etc.) (Berg, 2001; Curell & Urquhart, 2003; Larrabee et al., 2001). This is a documentation practice that is time consuming and inefficient (Scott et al., 2007). Although EHR increases information access and improves organization and efficiency, the EHR also increases documentation time (Kossman, 2006). The lack of utilization of existing patient information in the EHR between health care professionals can lead to extensive information overlap and flaws (Goedert, 2008; IOM, 2003).

The findings on information overlap indicate that current documentation practices do not efficiently support interdisciplinary work processes and decision-making (IOM, 2001; Iowa Nurse Reporter, 2002). With regards to information models in the EHR system itself, one could argue that most EHR systems are based on proprietary information models (ISO 215 Technical report, 2003). Well-documented concerns includes that current EHRs tend to be non- intuitive and inflexible in everyday use, proprietary, expensive, difficult to maintain

and rarely interoperable across health systems (Amatayakul, 2005; Brunt et al., 1999; Hayrinen et al., 2007; HL7 EHR, 2010; ISO 215 Technical report, 2003).

As most EHR systems, the EHR at the main study site is basically an electronic document management system, where the paper based structure of the patient record determines documentation of health care delivery (Amatayakul, 2005; Helsetilsynet, 2009; Kalra, 2006). Against this background, one may argue that the identified common information overlap between nurses' and physicians' admission notes and discharge summaries is reflecting, and is a function of, current structures (Norwegian record) of the EHR.

Information overlap may be a sign of redundancy. Studies reported in the literature discuss both positive and negative aspects of redundancy of information or information overlap (Cabitza et al., 2005). The question of redundancy of information is twofold: 1) accessibility of relevant and updated information in the EHR, and 2) potential risk of information flaws. To meet legal and professional documentation requirements for continuity of care, nurses and physicians have to utilize available computerized documentation systems in the clinical settings. In that sense, redundancy is understandable, and could be considered to be a consequence of the lack of semantic and functional interoperability in existing EHR systems (Helsetilsynet, 2009; IOM, 2003; ISO 215 Technical report, 2003). This organization of information in the EHR is in compliance with contemporary guidelines and recommendations for structuring information in the EHR systems in Norway (Helsetilsynet, 2009; KITH, 2001) and supported by professionals' requirements (Helleso & Ruland, 2001; Nystadnes, 2001; SykIT, 2000).

In the mid-nineties, the patient record had become one shared record, and restructured according to existing guidelines, also named the Piene structure in the Norwegian record (section 2.2.1). Although the patient has one record accessible to all health care providers, the implemented information model with suggestions for separate chapters is likely to contribute to generate information overlap in nurses and physicians' documentation. In that sense, it is reason to believe that the information overlap found in this study contributes to fulfill legal and each professions' documentation standards, and serves to meet need for patient information by each profession separately in the continuum of care (HOD, 2001a; HOD, 2001b).

At the same time, there is a discrepancy between the information model and the current structure in the EHR, and the international and national standards of health care documentation systems. These standards are based on the concept of interdisciplinary access, and exchange of information as a key to quality of care and future patient-clinician relationship. Effective interdisciplinary exchange of patient information is an essential component of safe, efficient, and patient-centered care. Interdisciplinary access implies that health care providers have direct access to key, contextual and targeted information at every stage of the patient's care episode (ISO 215 Technical report, 2003; KITH, 2001).

While EHRs process data, one must remember EHRs do not coordinate care, clinicians' communication and collaboration. EHRs must be presented and used as a tool for streamlining the capture and presentation of information that enable clinicians to coordinate care more efficiently and effectively (Hillestad, 2005; Jamal et al., 2009).

A major challenge for documentation of health care when introducing an EHR, are the tensions between current legal requirements and standardization demands (ISO 215 Technical report, 2003). In Norway, the introduction of a new Health Personnel Act (HOD, 2001a) happened concurrently with the implementation of the EHR in large health care organizations. However, the development process of the Norwegian EHR began in the mid-nineties (Helleso & Ruland, 2001; Husby, 2008; KITH, 2001), and the normative inputs from the new legislation were taken into consideration later. The major normative inputs from the legislation together with the ISO Standard in 2003 were as follows (section 2.3.2):

- The patient has one record that is personal, and contains retrospective, concurrent, prospective information.
- The primary purpose is to support continuous, efficient, and quality *integrated* health care
- The legislation does not distinguish between health care professionals regarding documentation requirements
- The key point of an EHR system is *interoperability*; the ability to share health information between different authorized users

The findings from the study of information overlap in admission notes and discharge summaries indicate that integration of information between nurses and physicians is not present, hence the major information overlap. The challenges to integrate information between nurses and physicians documentation are not only connected to the EHR system itself, but also to professional and cultural boundaries. Several professional challenges, or even obstacles to interdisciplinary documentation practice, are identified in the literature. There is a well-established, traditional culture of dividing the documentation of health care into medical records and nursing records (Carrajo, Penas, Melcon, Gonzalez, & Couto, 2008; England, 1993; Helsetilsynet, 2009). It should be remembered that nurses had no formal, legal obligations in documenting health care in Norway until the introduction of the Health Personnel Act in 2001, while the medical documentation practice has been regulated from the year 1927 (Waal, 2009). The concept of ubiquitous accessibility and interdisciplinary documentation of health care is relatively new, and ubiquitous access is limited to point of access to the information, not the presentation of information and documentation (Abraham et al., 2008; Green & Thomas, 2008; Hayrinen et al., 2007).

There are mutual challenges in documentation of health care by nurses and physician related to system design, interdisciplinary, professionalism, culture and tradition. As pointed out in the literature, successful transition from profession-based to a patient centered documentation practice requires inter-professional respect and acknowledgement (Davidson et al., 2004; Green & Thomas, 2008). Findings in this study suggest that further progress towards shared documentation of health care delivery when an EHR is introduced, depends on: 1) the system designs itself and 2) the ability of nurses and physicians to overcome cultural and professional obstacles.

Professional scopes

The results from the study on information overlap show that the conceptual areas *medication, medical treatment plan and historical medical diagnosis* are substantially more documented by physicians than by nurses. Conceptual areas substantially more documented by nurses are *pain* and *outcome pain* (section 5.1). These areas illustrate complementarities and differences in professional scope between nurses and physicians. More importantly, the findings reflect a division of labor; the medical focus on diagnostic, medication and treatment perspectives (Gillett, 2006; Wittrup, 2006) compared to the nursing focus on

patient conditions, aspects of pain, and basic human needs (Fischbach, 1991; Henderson, 1966). These findings also reflect core professional aspects in nurses' initial assessment of patient needs, and perspectives of patient expressions. The individual patient care approach is emphasized by documenting the patient's own expression of pain, which is in accordance with fundamental issues in nursing (Gortner, 1990; Henderson, 1966; ICN, 2010), as well as in accordance with legal demands (HOD, 2000; HOD, 2001a).

The different documentation practice of nurses and physicians can be related to differences in professional orientation, scope and roles; the caring perspective in nursing (Jasmine, 2009) and the cure perspective in medicine (Kim, 2001; Weed & Weed, 1999; Wittrup, 2006). The caring perspective in nursing and the cure perspective in medicine can be illustrated by how nurses and physicians assess the complexity of pain. The nurse observes and documents localization, patient expressions and vital data, and performs non-medical independent interventions like presence, communicative actions, offering comforting positions and general care (Fischbach, 1991). In addition, the nurse reports observations and effects of treatment to the physician, as well as suggesting and administering prescribed medications. The medical perspective of cure can be illustrated by the diagnostic assessment of pain, where localization and intensity are major data in the diagnostic process, determining the cause of the pain (Walker, 2005; Weed, 1975). The process depends on medical clinical judgments as well as documented observational and administrative data from nurses. The physician prescribes medication and determines follow-up procedures and treatment. The finding on the conceptual area *outcome pain* in the discharge summary was that the nurses document this type of information in 49 of 50 records, while physicians document this area in nine of 50 records (table 18, section 5.1.2). This illustrates differences in professional attention to cure and care, and the influence on documentation practices and clinical workflow, particularly for the concept of pain.

At the same time, these findings illustrate that the medical focus on "cure", like *medical diagnosis* and *previous medical diagnosis* have priority in the initial admission note by nurses also. Nurses documented medical diagnosis in 39 of 50 patient records. Only documentation of the conceptual area *pain* in the admission note and *outcome pain* in the discharge summary may be interpreted to reflect the nursing aspect of "care". The domination of medical focus in nursing documentation supports the perspective of nurses as key collectors and distributors of patient information in the EHR and the practice of

documenting medical assessments and prescriptions (Papathanasiou et al., 2007; Sahlstedt et al., 1997).

If the conceptual area *relative(s) expression* was relevant, both professions had equal scores in the admission note on this item. It seems to be a common documentation practice that nurses and physicians take into consideration and document views and information from the patient relatives upon admission. This is in line with the recommendations from the Norwegian legislation stating that patient and relatives views are to be a part of all care planning and treatment. The legislation also states that documentation of given information to patient and relatives is mandatory (HOD, 2001b).

The findings indicate that the documentation practice on the longitudinal aspect of retrospective views of health status and activities seems to be well documented, in particular by the physicians. The conceptual area *previous medical diagnosis* reflects the retrospective aspect in the admission note. The conceptual areas *historical medical diagnosis* and *medical treatment* reflects the aspects of retrospective views in the discharge summary.

The longitudinal aspect of concurrent view of health status and activities seems to be sufficiently documented. The results on the conceptual area *patient status* show that both nurses and physicians document this area in the admission note (49 of 50 patient records). Physicians document *medication* in 46 patient records. Current treatment is generally more documented by nurses (31 patient records) than by physicians (24 patient records). In the discharge note, the results show that nurses and physicians document *patient status* in 30 of 50 patient records. However, the nurse documents *patient status* in all discharge summaries.

Studies elaborating on “time delay of accessibility” of nurses’ and physicians’ notes in the EHR were not found in the literature. The next chapter discusses the findings on time delay and accessibility measuring the point in time when the admission notes and discharge summaries are accessible in the EHR.

6.3 Information flow and Accessibility of Charted Notes

The findings from measuring time delay showed that the admissions note written by nurses was on average accessible as a signed document in the EHR 4.8 hours earlier compared to the physicians' admission notes (table 19, section 5.2.1). The confidence interval estimation shows that the difference is statistically significant. The discharge summary written by nurses was on average accessible and signed in the EHR 9.0 hours earlier compared to the discharge summaries from the physicians (table 20, section 5.2.1). The confidence interval estimation shows that the time delay between nurses' and physicians' discharge notes is statistically significant.

The average time delay of 4.8 hours before the admission note is accessible, may be related to work-processes, such as how and when the information is entered to the EHR. The nurse collects and obtains relevant medical and nursing information on the patient. This information is keyed into the admission note for continuity in patient care when the patient is admitted to hospital, transferred to another hospital, in rehabilitation or in home care. The only updated patient documentation in the EHR during this period is the nurse admission note (Figure 1: Information flow sheet, section 3.4.2). This may cause information overlap due to the different methods of entering the information in the EHR, as discussed in the previous section (IOM, 2001; Iowa Nurse Reporter, 2002).

The nurse has to gather information independently of the reviews of the physician when information is processed in the admission note. However, the physician may have access to the initial admission note from the nurse upon the time of dictation, but the material does not reveal if this was the case when the note was dictated (beyond scope of the study). An interesting point is that, according to the findings on time delay, medical judgments are not available in the EHR when nurses write their admission note. At the same time, the examples (findings) may illustrate the complementary function in decision making of nurses and physicians.

The delayed accessibility is also due to different methods of recording information in the EHR; the nurse documents directly to the EHR, while the physician dictates a note, which is later transcribed by a secretary during the day or evening. The dictation is presumably time saving for the physician, while the transcription process with signing procedures is probably

time consuming. The results in this study is supported by findings in the literature that cooperative and multi-professional documentation systems have been developed, but not integrated (Claflin, 2000; De Clercq, 2008b), and that profession-based documentation systems prevent the integration of information between health care providers (Allan & Englebright, 2000; Lumpkins & Veal, 1995; Margalit et al., 2009).

The findings also indicate that the function of EHR as a major tool for interdisciplinary communication (section 2.3.2) is slightly exaggerated, and that synchronous information exchange is more typical of communication between nurses and physicians (Coiera et al., 2002). Common overviews in the EHR, where the health care providers can view patient data in one document, are not present in this material. There are no indications of information exchange (Garde, Knaup, Hovenga, & Heard, 2007) with other health care providers either in the nurses' or physicians' charted notes. When the notes by nurses and physicians were examined during the instrument development process, all notes had to be assessed separately because this is how the EHR system is structured in the main study site (Helsetilsynet, 2009).

When health care professionals access the patient record, they search and document within their own professional group, and not in a context of common multi-professional notes or documents. It is reason to believe that the real nature of the communication between nurses and physicians is not reflected in the EHR, because the communication is synchronous, as pointed out by Alvarez and Coiera (2006).

In clinical practice, nurses and physicians communicate continuously face-to-face about patients' problems, observations and assessment (Alvarez & Coiera, 2006; Bokhour, 2006; Bricon-Souf et al., 2006). The nurses have a long tradition in documenting activities following from physicians' orders, judgments and prescriptions (Gordon, 2005; Sandelowski, 2000). This tradition seems to continue in the current documentation practice in the EHR. The findings from audit support reflections in the literature that major professional challenges towards an interdisciplinary documentation practice lays in the intersection between professional scopes and roles and in day-to-day work practices (Willis & Parish, 1997; Zwarenstein, Goldman, & Reeves, 2009).

The time delay of the discharge summary in the EHR between nurses and physicians is higher than for the admission note. The physician note is not accessible until 9 hours (mean) after the nurses' discharge summary has been recorded and signed. Any time delay in the accessibility between nurses and physicians discharge summaries is problematic, because medical information on patient status, outcomes of treatment and care, and the patients' previous and current medication is not available. Thus, drawing on the findings on time delay, no medical information provided by physicians follows the patient to home care, nursing homes or other health care institutions when the patient is discharged from the hospital. The discharge summary by the physician is sent to the primary physician in charge of the patient, not to the patient or to the institution where the patient is actually transferred (KITH, 2002). The implication of this practice for the continuum of patient care is substantial and reveals insufficient information exchange, not only between health care providers, but also between organizational levels and to the patient upon discharge from hospital.

The time delay in accessibility between nurses and physicians charted notes in the EHR is fundamental to understanding the content of information available when decisions are made regarding treatment and care of the patient. Although communication of patient status and recommendations/prescriptions are provided by phone or direct communication (Bricon-Souf et al., 2006) (Toussaint & Coiera, 2005; Alvarez & Coiera, 2006), the time delay of documented examination and judgments leaves room for misunderstandings and errors. On the other hand, it is well known in the literature that nurses suffer from lack of knowledge about the patient's medical case, and in particular, the contexts of medical decision making in a synchronous work organization (Schoop & Wastell, 1999). Shared knowledge about the patient is weakened by the asynchronous work organization. An asynchronous work organization is, according to the literature, characterized by split medical rounds where the nurses and physicians do separate rounds (Beuscart-Zephir et al., 2007). In that sense, it is reason to believe that synchronous communication environments counterbalance lack of current, updated, accessible documentation in the EHR.

The accumulating history of care and treatment (Lee, 2007) aspect of an EHR, in addition to interoperability, is pointed out in the literature as a core factor for health care providers in supporting clinical workflow, communication and integration of patient health information in the EHR. The longitudinal approach implies a retrospective, concurrent and prospective

view of health status and activities (Amatayakul, 2009; Burton, Anderson, & Kues, 2004; Garde et al., 2007; ISO 215 Technical report, 2003). As discussed earlier in this chapter, the EHR system at the main study site does not sufficiently provide for integration of information between nurses and physicians, because the information by nurses and physicians is structured in separate silos (Helsetilsynet, 2009; KITH, 2001). The system does not provide common overviews in transition between in-hospital departments or different health care levels.

It is pointed out in the literature that professional issues and scopes of practice can explain the lack of attention, interest, and research of interdisciplinary documentation practices. Scandinavian publications reflect concerns for the quality of the nursing documentation, development and implementation of nursing documentation models, and development of audit instruments to assess the quality of the nursing documentation. The focus in the Scandinavian nursing community has been to scientifically establish and evaluate a nursing documentation model (Bjorvell et al., 2000; Ehnfors et al., 1998; Ehrenberg & Ehnfors, 1999a; Einarson et al., 2001). In contrast to the findings from the Scandinavian literature, the international publications take more interest in the development of standardized terminologies for health care, and the implications of nursing information systems or technology on the documentation practice (Agrawal & Johnson, 2006; Ball, Douglas, & Hoehn, 1997; Betts et al., 2003). Drawing on the literature, it is pointed out that professional communities are not very concerned with the interdisciplinary and technological aspects of documentation in the EHR, although in the collaborative articles of nursing and medicine, the focus changes towards teamwork and workflow (Davidson et al., 2004; Leth et al., 2005). In medicine, however, the concern is not the content and structure of the documentation, but more the implications of system failures and system development that creates inefficiency, is time consuming, and does not support the information flow in terms of clinical workflow of physicians (De Mul & Berg, 2006; Fenton & Gamm, 2007).

The information handling and discharge planning is not based on available computerized tools, because there are no references or links available in the admission note and discharge summary in the EHR. The information is not tagged in such a way in the current EHR that it enables automated retrieval from existing documents when writing up the discharge summary. Nurses have to manually copy and paste relevant information to their discharge summary from documents in the nurse and physician record. The physicians repeat

information documented in the physician record when they dictate the discharge summary. The lack of semantic interoperability, a common terminology or use of any classification system in the current EHR system makes retrieval of consistent information from one conceptual area almost like searching for a “needle in the haystack”. In order to secure patient centered care, standardization of the assessment of the language and communication are seen as crucial (Abraham et al., 2008; Amatayakul, 2005; Kohl, Schott, Verveur, Poschl, & Knaup, 2007). These considerations are in line with earlier recommendations; to improve and secure the quality of documentation, identification of and consensus about key areas is crucial for accurate and reflective patient records (Nailon, 2007; Taylor, 2003).

The overall advantage of the common conceptual areas in B-HIOS, is that they are derived from a synthesis of the current documentation practice in the EHR, from legislation and from professional standards. As such, the empirically driven synthesis expressed as overlapping conceptual areas might be applied to the contemporary EHR admission note and discharge summary. However, this process is improved with the introduction of templates with standard text/headings and a restructuring of how the information is processed in the EHR (Brunt et al., 1999; Byers, Genovich-Richards, & Unruh, 2007; Kjekken et al., 2008).

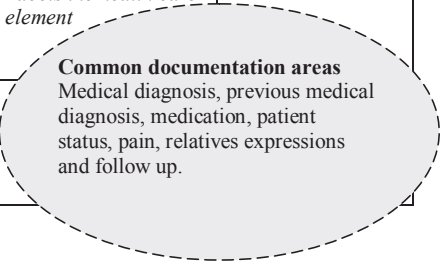
The common conceptual areas identified in the admission note and discharge summaries can be information items in a common, collaboratively written note (shared), providing immediate access to this particular information gathered and documented in the patient’s EHR. This may be the first step towards an interdisciplinary documentation practice with common overviews, at least on information within the admission note and discharge summary. The conceptual areas may serve as input to a common template with areas where nurses and physicians document complementary information according to professional scopes and requirements. This would be an important step towards a multi-professional documentation practice in the EHR, where the patient information is shared and structured according to common health care elements.

The longer-term target towards an interdisciplinary documentation practice could be to implement a multi-professional problem based documentation model in the EHR, using common terminology systems and the problem-based approach to documentation of health care delivery (Davidson et al., 2004; De Clercq, 2008). Such multi-professional

documentation secures continuity of care and is a prerequisite of a safe and transparent documentation practice. The overlapping conceptual areas can be applied to a problem-based multi-professional EHR because this model, as well as the instrument development process in this study, is based on the relation between nurses' and physicians' documentation of health care in the EHR. The model (De Clercq, 2008) comprises six basic concepts, as displayed in table 6 (section 2.3.2). These areas are the common conceptual areas, which all health care providers enter when processing information in an EHR. In other words, a multidisciplinary approach to documentation of health care does not collect information according to profession, but according to basic concepts related to the patient.

In order to exemplify the applicability and relevance of the identified common conceptual areas between nurses and physicians in the admission note to the multi-professional model, integration of the basic concepts *the health care element* and *the health approach* from table 7, is displayed in the following table.

Table 21: Applicability of common conceptual areas to basic concepts in a multi-professional model of the EHR

Basic concepts	Description	Nursing ↔ Medicine	
The Health Care element	<i>First level of meta-information, patient oriented Can be identified by several professions, cooperation</i>	<i>Related mainly to one of the 14 basic patient needs Main and secondary diagnosis Labels the health care element</i>	<i>Pathology, main and secondary diagnosis linked to a health plan</i>
The Health Approach	<i>Belongs to one health agent Professionals work around the same health care element according to their own objectives</i>	 <p>Common documentation areas Medical diagnosis, previous medical diagnosis, medication, patient status, pain, relatives expressions and follow up.</p>	

(Derived from De Clercq, 2008)

The multi-professional problem based documentation model consistently approaches documentation of health care around the health care element and consequently puts the patient needs and situation in the center of documentation practice. The model also implies

the use of common terminologies or classification systems, in particular related to diagnosis (De Clercq, 2008).

According to the literature, the medical hegemony in health care organizations conceals the real relationship between nurses and physicians in the day-to-day work practices. The nursing role, whilst pivotal to implementing clinical decisions, remains unacknowledged and devalued in clinical settings (Coombs & Ersser, 2004). This carries ramifications for documentation and information access in the team decision-making and search for new ways of inter-professional collaboration. Significant challenges to establish collaborative workflow lies in traditional perceptions of health care work, professionalism, and historical practice (Abraham et al., 2008; Davidson et al., 2004; Laughlin & Van, 2003). Another key point to explain the lack of interdisciplinary focus in documentation of health care is that the physicians' documentation practice is hardly mentioned in this selection of literature. The overall impression from the literature is that physicians do not pay attention to the content of their electronically charted notes (Friedman et al., 2007; Physician Documentation Expert Panel, 2006b; Simon et al., 2007). In that sense, nurses and physicians share an intra-professional documentation practice where the notes are written primarily for colleagues/fellow professionals rather than the common perspectives of patient care. The question of interdisciplinary documentation remains a rather unexplored issue in the current documentation practice of nurses and physicians.

7.0 CONCLUSIONS

This dissertation set out to explore interdisciplinary documentation in the EHR. The goal was to contribute to a documentation practice in the EHR that is patient-centered, safe, timely, efficient, and equitable. The primary objective was to describe some aspects of interdisciplinary clinical documentation practice by nurses and physicians in the EHR, with emphasis on information overlap and information flow. A secondary objective was to develop and validate an instrument for assessing degree of information overlap and similarities between nurses and physicians.

The following research questions were explored:

- 1) To what degree is there information overlap between nurses and physicians in documentation of patient care in the EHR?
- 2) In documentation of patient care in the EHR: Which information items between nurses and physicians are common?
- 3) How large is the time delay between accessibility of nursing and physician documentation of patient care in the EHR?

According to the literature, multi-professional EHRs or an interdisciplinary documentation practice is not implemented, explored, or evaluated. Interdisciplinary information sharing and work processes related to documentation of health care in the EHR has not been sufficiently addressed in the literature. To the best of my knowledge, none of the previous studies has measured the accessibility of the charted notes (time delay) in the EHR for nurses and physicians, or the size of the notes after implementation of an EHR. The most important findings in the literature regarding the topics in this dissertation were that the issues of information overlap between nurses and physicians in the charted notes were not discussed or explored.

To contribute to knowledge in this area, a new instrument was developed and tested. The instrument development process resulted in a 24-item questionnaire with five score categories. In addition to measuring information overlap between nurses and physicians in

the admission notes and discharge summaries, the instrument enabled identification of professional scopes and conceptual areas (items) that was not documented. The new instrument was named Bormark Health Information Overlap Scale (B-HIOS). The B-HIOS instrument was not designed for diagnostic purposes, and, in order to enable measurement of reliability in the material, a modified kappa method was developed, measuring 21 of 24 items. The validation of the instrument revealed that four items in the admission note, and seven items in the discharge summary, did not meet the criteria of acceptable inter-rater reliability. The findings indicate that the modified kappa method is more appropriate for measuring rater agreement of non-diagnostic scales than is the original kappa method. After refinement, the final instrument consists of seven items for the admission note, and six items for the discharge summary.

The results on measuring information overlap showed that five of seven items in the admission note and all items in the discharge summary (6) were overlapping between nurses and physicians for the same patient. These items were *medical diagnosis*, *previous medical diagnosis*, *patient status*, *pain* and *medical treatment plan* in the admission note. In the discharge summary the overlapping items were: *medical diagnosis*, *medication*, *outcome* *pain*, *historical medical diagnosis*, *follow up activity* and *follow up appointments*.

The overlapping items in the nurses' and physicians' documentation illustrate the two professions' documentation scope. It is a shared focus on items including current and previous medical diagnosis and treatment, medical planning, patient status upon admission and as well as descriptions and assessment of pain follow up activity and appointments.

The items *medications*, *medical treatment plan* and *historical medical diagnosis* were substantially more documented by physicians than by nurses. Items substantially more documented by nurses are *pain* and *outcome pain*. The findings reflect an operating division of labor; the medical focus on diagnostic, medication and treatment perspectives, compared to the nursing focus on patient conditions and aspects of pain. The prominent medical focus in the nursing documentation, in regards to the overlapping items, supports the perspective of nurses as key collectors and distributors of patient information in the EHR, and the practice of documenting medical assessments and prescriptions. The findings on common conceptual areas identified in admission notes and discharge summaries can be information items in a common, collaboratively written note (shared) providing immediate access to this particular information gathered and documented in the patient's EHR. The long-term target

towards an interdisciplinary documentation practice could be to implement a multi-professional problem based documentation model in the EHR, using common terminology systems and the problem-based approach to documentation of health care delivery.

Measurements on information flow in terms of time delay in the admission notes and discharge summaries between nurses and physicians showed that the nurses charting are available and signed in the EHR *before* charting by the physicians. The admission notes written by nurses is accessible as a signed document in the EHR 4.8 hours earlier compared to the admission notes from the physicians. The discharge summary written by nurses is accessible and signed in the EHR 9.0 hours earlier compared to the discharge summaries from the physicians. The nurses' discharge summary is the only documentation available to the patient and other health care professionals upon discharge and transfer to another institution/primary care. The nurses transcribe and sign their notes directly to the EHR. The transcription process by physicians is not as timely as the nurses because the information is dictated, not entered directly to the EHR. According to these findings on time delay, medical judgments were not available in the EHR when nurses wrote their admission note and discharge summary. Any time delay in the accessibility and information flow between nurses and physicians discharge summaries is problematic. The medical information on patient status, outcomes of medical treatment and the patients' previous and current medication is not available. The discharge summaries by the physician is sent to the primary physician in charge of the patient, not to the patient or to the institution where the patient is transferred. The implication of this practice on the continuum of patient care is substantial and reveals insufficient information exchange, not only between health care providers, but also between organizational levels and to the patient upon discharge from hospital. This is a serious threat to the quality of care by inhibiting information flow in the continuum of care.

7.1 Recommendations

Recommendations for future research are within three major areas. First, the lack of “gold standards” regarding interdisciplinary communication and documentation calls for further research, which can contribute to the development of common information models, terminology and classification systems of health care. It is also highly recommended to do research on the applicability of the identified common conceptual areas for the development a multi-professional documentation model in the EHR and to reference terminology systems like ICNP (International Classification Nursing Practice). Future modulation of the EHR must take into consideration clinical work-processes, and new studies are recommended on the streamlining of computerized documentation practice according to professional demands and support.

Secondly, based on the results from this study, one should consider the implementation of shared documents between nurses and physicians in the EHR. Such implementation should include a structural change from a parallel to a patient-centered documentation practice in line with the *openEHR* framework. Additional research and refinement of the B-HIOS is recommended in this process. The third recommendation implies future professional and governmental priorities in the development of the Norwegian EHR. It is crucial to change the structure and content of the EHR to make health care safe, effective, timely, efficient, equitable, and patient-centered. This common goal will not be achieved by continuing a parallel documentation practice and a proprietary EHR system. The development of a multi-professional EHR is crucial, and further research should be initialized in an international context.

7.2 Contribution to Knowledge

This research on information overlap and timely access to nurses' and physicians' documented notes in the EHR provides new insights and knowledge on current documentation practice by nurses and physicians in the EHR. This study also provides new insights on the validation process of an instrument with non-diagnostic scales. One of the contributions of this study is the identification of common documentation conceptual areas between nurses and physicians, as well as areas specifically documented by one of the professions. Core aspects of the documentation practice of nurses and physicians on planning, judgments and outcomes are absent or insufficient. This also sheds light on core medical and nursing scopes that is well documented in the literature, but not highlighted in an interdisciplinary perspective. Nurses and physicians share common goals in delivery of health care and they complement each other in the daily clinical work. This is not reflected in the current documentation practice in the EHR, and the documentation practice by nurses and physicians is not interdisciplinary but profession-based. The current intra-professional documentation practice leads to a situation where the notes address fellow professionals more than the common perspectives of patient care. It is little knowledge about the ways in which nurses and physicians work out their charted notes in an EHR. This study shows that the notes by nurses do not necessarily complement previous notes by fellow nurses. The current documentation practice is time consuming, inefficient and leads to redundancy of patient information.

The common conceptual areas between nurses' and physicians' admission notes and discharge summaries, as identified in this study, may contribute to interdisciplinary documentation in the form of a common problem-based conceptual model in the EHR. A new instrument capturing information overlap between nurses' and physicians' admission notes and discharge summaries in the EHR has been developed in this study. The refinement process of the instrument revealed that the traditional kappa inter-rater measurement method had some insufficiencies. A modified kappa method was constructed, which is more applicable to non-diagnostic scales and recommendable to similar score categories when validating other instruments. The B-HIOS instrument is a contribution to increased quality of documentation practice in the EHR by supporting and identifying common professional interdisciplinary documentation foci and conceptual areas. The instrument captures deficiencies in documenting health care delivery.

7.3 Limitations

The patient record reviews, which contributed to the instrument development, were based on all charted notes by nurses and physicians in the selected Norwegian and North American EHRs. In retrospective, this led to identification of conceptual areas not representative of the documentation demands and practice in the admission and discharge summaries at the main study site. However, these conceptual areas were captured and removed in the validation process. The validation of B-HIOS could have been further strengthened by a peer review of the identified conceptual areas before application of the instrument, in particular by physicians. The reason for the lack of such a peer review was a tight time schedule with few resources available to administer and perform a peer review at this point. However, the item identification process was based on the documentation in authentic EHRs, and is thus representative of how physicians document/write their notes. In the inter-rater validation of the instrument, it would probably be appropriate to add raters that have a medical background to strengthen the results and applicability of the instrument. However, the inter-rater measurement was considered appropriate and in accordance with recommendations from the literature, and similar measurements from other studies. The insight and experience from the inter-raters were considered more important and efficient regarding reliable scoring capabilities than a wider contribution from the medical field.

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APPENDICES

- Appendix 1: Example 1: Admission Note in the VistA EHR
- Appendix 2: Example 2: Admission notes in DocuLive EHR
- Appendix 3: Recommendations and approvals of the research project by director of Orthoedic Centre and Data Protection Officer, Ullevaal University Hospital, Oslo, Norway.
- Appendix 4: IRB review and approval, University of California, San Diego Human Research Protection Program, USA.

APPENDIX 1**Example 1: Admission note in the VISTA EHR*****Nurses Admission note*****TITLE:** Nursing Admission Assessment**STATUS:** COMPLETED - Patient has correct wristband**AGE:** 57**SEX:** Male**MARITAL STATUS:** Married**RACE:** White, not of Hispanic origin**TRANSPORTED TO HOSPITAL BY:** Patient**INFO OBTAINED FROM:** Patient**HAIR:** Brown**EYES:** Hazel**DISTINGUISHING MARKS:** SCAR: rlq**RELIGION:** Protestant, other**Date/time Height/Weight Taken:****Height (in):** 72 **(cm):** 182.9**Weight (Anoshiravani, Gaskin, Groshek, Kuelbs, & Longhurst, 2012):** 250

(Gebu, Ahsberg, & Willman, 2006): 113.6

BMI: 33.96 **BSA:** 2.4===== **VITAL SIGNS** =====

Time Taken	Temp	Pulse	Resp	B/P	FS	POx	Pain
06:31		97.1	64	20	95/51	93%	6

BP Position: Lying **BP Site:** Right arm

06:34 61 102/54 95%

BP Position: Lying **BP Site:** Right arm===== **DISPOSITION OF VALUABLES** =====

Remained with patient - Glasses/Contacts

Remained with patient – Clothing

Other info concerning valuables: ASU 5B

===== **MENTAL STATUS** =====

Alert, Always oriented to person, always oriented to place, always oriented to Time, Understands/Follows instructions, speaks clearly, Mood: Calm.

===== **RECENT MEDICAL/SURGICAL HISTORY** =====

REFER TO H/P (comment by author: means History and Physical examination)

===== **NEUROSENSORY** =====

No neurosensation problem noted, Hand grasps equal, Pain scale of 0-10 taught or reviewed, Verbalizes understanding of pain scale, Patient's stated Acceptable Pain Level: 6, Pain is satisfactorily controlled,

PAIN #1 - Location: both lower extremities. CONSTANT non-radiating pain. Began years ago and continues. Pain severity 6 out of 10. Movement makes pain worse. Analgesia makes pain better. Denies visual problems, hard of hearing left ear, hard of hearing right ear, deny sleep problems.

===== **INITIAL LEARNING ASSESSMENT** =====

Able to read, Speaks English, No Learning barriers or Limitations to learning, No Areas of Cultural Beliefs/Practices patient would like addressed, Adequate motivation/readiness to learn, Prefers to learn by hearing, **Patient's understanding of Medical Condition (in patient's own words):** "METAL LEFT KNEE",

Patient stated expected length of stay is: 5 days, Patient stated length of stay is realistic; Patient's knowledge of medical condition is adequate,

===== **INITIAL DISCHARGE PLAN** =====

Planned destination upon discharge: Patient's Home, Estimated days until discharge: 6 days, Patient's Discharge concerns: NONE, Patient's Health concerns: NONE, Age-related concerns: MIDDLE ADULT,

===== **ALLERGIES / MEDICATIONS** =====

No New Allergies, Known Allergies Reviewed, No Allergy to LATEX (rubber),

ALLERGIES: No Allergy data found

No Problems with Current Medications, Medications that were brought to the hospital have been sent home, Patient took routine medications today - last taken at: 0430, Medications listed in computer,

Medication History List: Comments by author: Not listed/displayed

===== **CARDIOVASCULAR** =====

Cardiac rhythm (via peripheral pulse) is regular, No lower extremity edema noted,

===== **REPRODUCTIVE** =====

No history of sexually transmitted diseases reported, No male reproductive organ discharge, No history of erectile dysfunction reported,

===== **MUSCULOSKELETAL** =====

Weakness of: Both legs,

Assessment of Pulses:

PRESENT - [Right] Brachial pulse

PRESENT - [Left] Brachial pulse

PRESENT - [Right] Radial pulse

PRESENT - [Left] Radial pulse

PRESENT - [Right] Pedal pulse

PRESENT - [Left] Pedal pulse

===== **RESPIRATORY** =====

No C/O difficulty breathing, Unlabored breathing, Right lung sounds - clear, Left lung sounds - clear, No respiratory treatments, No C/O cough,

===== **NUTRITION** =====

Denies nutrition problem, Regular diet,

===== **ELIMINATION** =====

BOWELS: Denies bowel problems, Bowel sounds present,

URINARY: Denies urinary problems,

===== **DIABETES** =====

Patient is not diabetic,

===== **ADVANCE DIRECTIVES** =====

Patient does not have an Advance directive and does not want one at this time,

===== **SKIN INTEGRITY** =====

Skin: Patient denies skin problems, warm and dry, Norton Scale: 19. Skin Risk Level: No Risk

===== **FUNCTIONAL ASSESSMENT** =====

No balance problem. Independent with ADL's. No problem eating or drinking. No communication problem,
No pain with ADL's,
Morse Fall Risk Score: Low Risk 15

= ===== **PSYCHOSOCIAL** =====

No abuse concerns, No significant Hx of alcohol use. No significant Hx of drug use.
No mental health concerns, No Hospitalization/Family problems. No Legal Concerns.

===== **LIVING ARRANGEMENTS / SUPPORT SYSTEMS** =====

SUPPORT SYSTEMS: Assistance from family members available,

===== **PROBLEMS** =====

Pain. Hearing Problem. Musculoskeletal Problem.

First MD Note: Comment by author: This is an Operative note and is not included in this example, but this is the first note on the patient by an MD in the VistA EHR. The next note by the physician is the ASU Admission note.

ASU Admission Note

Physician Admission H&P

GENERAL REVIEW

CHIEF COMPLAINT(s): knee pain

PRESENT ILLNESS: 64 yrs Male with Left Knee DJD. S/P L Knee Arthroscopy / with 2b and 3a changes Predominant medial/PF Compartments: Pt. c/o pain 6/10, +Nite pain, walking of approx 100 yds. Therapies tried: Nsaids, SI with on short-term sx relief, Unloader Brace. His sx improved somewhat with scope, but pain remains sign enough that he wishes to proceed with TKA. Pt. was cleared medically

1/05 X-Ray: A tiny effusion is again seen. Tricompartmental osteoarthritis, with severe joint space

narrowing of the medial compartment, is stable. There is mild joint space narrowing in the patellofemoral compartment on this side.

CURRENT PROBLEM LIST: Comments by author: Not listed, all problems classified to ICD-9

(23 problems)

Surgeries: Left Knee Scope, Appy

ALLERGIES

Patient has answered NKA. New Allergies: None

MEDICATIONS

Active Inpatient and Outpatient Medications (including Supplies):

Active Outpatient Medications: Comment by author: The list is not displayed.

ADDITIONAL MEDICATIONS: no

TRANSFUSION HX: None

SOCIAL HX

LIVES WITH: Wife. Lives on Sailboat.

SUBSTANCE USE/ABUSE:

Tob: never

Etoh—no

St. Drugs: no

OCCUPATIONAL HISTORY/Toxin Exposure: Probably many chemical/asbestos exposures

while working as a Ship Builder

FAMILY MEDICAL HISTORY:

Tuberculosis: no

Diabetes: no

Cancer: no

Hypertension: M dec 79 CVA/CAD, F dec 45 CVA

Cardiac: M

Mental Health:

REVIEW OF SYSTEMS:

ENT: +Glasses, Perm Caps, +HOH—no HAs, no sinus, no dysphagia.

Cardiac: no cp/palp/murmur/edema/mild doe/orthopnea/pnd.

PULM: +OSA with CPAP, no TB, and no cough
GI: no c/d/occas brbpr 2/2 hemorrhoids, no melena, no hep, no heartburn
GU: Noct x2, no dysuria, no gh
Neuro: no cva/tia/Sz/HA/Dizziness, Left Shoulder area of n/t
Heme: Bleeps easily

PHYSICAL EXAM:

VITAL SIGNS:

Temperature: F

Pulse: 70 bpm

Respiration: bpm

BP: 99/61 LA/Sit mmHg

Ht: 6'0" inches

Wt: 250# Reports Lbs

GENERAL APPEARANCE: Well developed, Well nourished, Well groomed

SKIN: Inspection: Multiple Sun Exposure Damage to Face/BUE/Chest/Back

EYES: Exam: PEERLA

ENT:

Nose: Patent, pink, moist, no discharge

Ears: Normal pinnae

Otoscopy: TMs Intact

Mouth: Exam unremarkable

Oropharynx: No erythema/exudate/lesions

Neck: Supple, no lad, no jvp, no carotid bruits

CARDIOVASCULAR:

Heart: Distant HS, RRR

Pulses:

Radial Femoral Popliteal DP

R: 2+ 2+ N/A 2+

L: 2+ 2+ N/A 2+

PULMONARY:

Chest Percussion: Exam unremarkable

Chest Palpation: Exam unremarkable

Auscultation of Lungs: Normal BS

ABDOMEN:

Abdominal exam: S, NT, + BS, no HSM, no CVAT

Anus inspection: Exam deferred

MUSCULOSKELETAL:

General: Antalgic Gait, + Varus Deformity, + Crepitus, n/v intact, no effusion/erythema/warmth

Left Knee ROM: 3-110 Stable v/v/pcl, 1+ ACL Laxity, no focal ttp

Digits: No clubbing, No cyanosis, No swelling

GENITOURINARY:

Prostate: N/A

GYN: N/A

NEUROLOGICAL:

General: CRANIAL NERVES: II-XII grossly intact

Sensation: Intact to light touch

PSYCHIATRIC: Alert and oriented to time, place and person

Initial Lab Studies: X-rays: Chest Palpation: Exam unremarkable

APPENDIX 2

Example 1: Admission notes in the DocuLive EHR

Admission note by nurse(s)	ADMISSION DEP.
<p>Time: 1005</p> <p>NURSING ANAMNESIS</p> <p>Reason for contact: Pat. fell today when getting into EHR car. She says that she started to shiver before she fell.</p> <p>Actual health- and nursing history: Surg. FCF earl. Surg. ulcer . . . Cer. Insult 2 years ago. Osteoporosis.</p> <p>Social background: Married</p> <p>GENERAL INFORMATION</p> <p>Source of information: Patient and personnel from the ambulance.</p> <p>Other information:</p> <p>PATIENT STATUS</p> <p>Communication: Awake, ready and oriented</p> <p>Respiration: N/A</p> <p>Circulation: N/A</p> <p>Nutrition: Last approx 0800, drank water approx. at 1100.</p> <p>Elimination: Not asked</p> <p>Skin/Tissue: Dry and warm skin. Wound left arm. Left leg shortened and out rotated.</p> <p>Activity:</p> <p>Pain/Sensory condition: Pain in the hip.</p> <p>Follow up:</p>	
ADMISSION STATUS ORTHOPEDIC DEP	Admitted
<p>orthopedic dep: 1630</p> <p>Reason for admission: Fasting for surgery</p> <p>Patient fell today when she was together with EHR husband. Says she felt unwell before</p>	

she fell. The couple lives together. No public assistance known. She has had a cer. insult before, has osteoporosis and surg. left hip before.

PATIENT STATUS

Communication: Awake and adequate. Seems ready and oriented.

Knowledge/Development:

Respiration/Circulation: BP: 145/80, P: 97, SaO₂: 96%. Dry and warm skin.

Nutrition: Fasting from 0800. Has only drunk one glass afterwards (at 1100).

Progressing 1000 R.A. i.v., and she can moisten EHR mouth in between with sponge.

Elimination: Urinated a little in the admission department. Says she is continent.

Skin/Tissue: A small scrape on left elbow that is covered. The surgical leg is swollen and out rotated, not marked.

Wound:

Activity:

Sleep:

Pain/Sensory condition:

Admission note by physician

ADMISSION DEP

Comment by author: Time of dictation not known. Time accessible in EHR: 2058 same day

Diagnosis: Subtrochant femur fracture left.

Family/Social: Lives with spouse.

Previous diseases: Had surgery stomach ulcer many years ago, probably Billroth II. Has also had medial colli femur fracture primary nailed and screws removed afterwards.

Actual: Fell outdoors today from own height. Trauma left hip. Clinical manifest fracture confirmed by x-ray that shows a subtrochant femur fracture. Hospitalization for surgery.

Natural functions: Problems with urine leakage.

Allergy: Not known

Fixed medication: Comment by author: Not listed/displayed.

Present status at 1500 Hour: 80-year-old woman, in bed on examination. Awake and affected by pain. Good cooperation.

BP: 145/80

Pulse: 104, regular.

Cor: Regular action without hearable bi-sounds.

Pulm: Light crepitations basal both sides.

Abdomen: Scars after earlier surgical interventions. Incidentally, soft, not sore.

Lower extremity: Varicose changes. Slim legs. Good pulse in a.d.p. bilat. Left leg out rotated and well trodden.

Resume: 80-year-old woman acute admission with a subtrochant femur fracture left.

Fasting before surgery and a 6-hole DHS with support plate are planned.

APPENDIX 3

1. Recommendations and approval of the research project by director of Orthopedic Centre, Lars Engebretsen, Ullevaal University Hospital, Oslo, Norway

2. Approval to process anonymous data in the research project by Data Protection Officer, Heidi Thorstensen, Ullevaal University Hospital, Oslo, Norway

08.09.03

 Ullevål universitetssykehus
 v/administrasjonen

**ANBEFALING OM STØTTE FOR GJENNOMFØRING AV
 DOKTORGRADSPROSJEKT FOR SYKEPLEIER SIDSEL R. BØRMARK**

*"THE DOCUMENTATION PRACTISE OF HEALTH CARE PROFESSIONALS IN THE
 ELECTRONIC PATIENT RECORD (EPR) AND THE IMPLICATION OF THE
 INTERDISCIPLINARY INFORMATICS APPROACH"*

Informasjonsteknologi er blitt av avgjørende betydning i sykehusene. Utviklingen går raskt og Sidsel Børmark har vært i frণten for denne utviklingen på Ullevål universitetssykehus den senere tid. Gjennom sitt arbeid på Ortopedisk Senter og etter hvert også hele sykehuset, er det blitt klart at Sidsel Børmark har den kompetanse og vilje til hardt arbeid som må til for å gjennomføre dette prosjektet. Som doktorgradsstipendiat i en 4 års periode vil hun bidra med svært viktige data for Ullevål universitetssykehus.

Ortopedisk Senter vil på sin side i denne perioden dekke driftsutgifter med følgende summer:

2004	kr.70 000,-
2005	kr.75 000,-
2006	kr.75 000,-
2007	kr.65 000,-

Vi vil også bidra på faglitteratur- og utstyrssiden. I tillegg vil undertegnede fungere som sideveileder i tillegg til veilederne som Børmark har ved Institutt for Sykepleievitenskap og sykepleieledelsen ved Ullevål universitetssykehus.

Hittil har liknende studier ikke vært gjennomført i Norge. Sidsel Børmark skal beskrive innholdet og kvaliteten av den skrevne dokumentasjonen i den elektroniske pasientjournalen ved Ullevål universitetssykehus. Videre skal hun studere hvorledes informasjonen overlapper mellom lege og sykepleiere. Hun skal også designe og teste en interdisiplinær pasientdokumentasjonsmetode som baserer seg på resultatene av den første delen av studien.

Det er ingen tvil om at det er et behov for nye organisasjonsmodeller som er pasientfokuset, vitenskapelig basert, outcome basert og ikke minst er interdisiplinært organisert. Jeg vil tro at Børmarks studier vil plassere Ullevål universitetssykehus i fronten når det gjelder dette området.

 Ullevål universitetssykehus HF
 0407 OSLO

 Telefon:
 22 11 74 64

 Besøksadresse:
 Kirkeveien 166

 Bankgiro:
 1644 06 05897

 Foretaksnr.:
 983 971 784

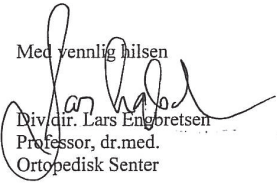
 Telefaks:
 23 01 52 70

 HELSE  ØST

Jeg vil også påpeke at det er svært viktig at Ullevål universitetssykehus får i gang sykepleiefaglige doktorgradsprosjekter. Ortopedisk Senter vil selvfølgelig tillate at studiene gjennomføres hos oss.

Vi vil på det sterkeste støtte Børmark i dette prosjektet, og ber om at sykehuset sentralt gjør det samme.

Med vennlig hilsen



Divdir. Lars Engbretsen
Professor, dr.med.
Ortopedisk Senter



Sissel Børmark
Oslo university hospital

Vår ref.: Deres ref.: Saksbeh.: Dato:
Oppgis ved all henvendelse 2.5.2012

— **Processing anonymous data in the research study –
Interdisciplinary documentation of health care in the EHR: Exploring information overlap**

Provided the following procedure, the analyses in this study is performed on anonymous material, and no formal approval is required:

- Authorised personnel accessing the patient journals and making sure that the documentation made available for Sissel Børmark is anonymous.

Best regards
Oslo university hospital

A handwritten signature in blue ink that reads "Heidi Thorstensen".

Heidi Thorstensen
Data Protection Officer



APPENDIX 4

**IRB approval, University of California, San Diego Human Research
Protection Program, USA**

060120



UNIVERSITY OF CALIFORNIA, SAN DIEGO
HUMAN RESEARCH PROTECTIONS PROGRAM

TO: Dr. Leslie Lenert Mailcode: 111N-1

RE: Project #060120 Documentation of Health Care in the nelectronic Patient Record
(EPR): Assessing Quality for Different Modalities.

Dear Dr. Lenert:

The above-referenced project was reviewed and approved by one of this institution's Institutional Review Boards in accordance with the requirements of the Code of Federal Regulations on the Protection of Human Subjects (45 CFR 46 and 21 CFR 50 and 56), including its relevant Subparts. This approval, based on the degree of risk, is for 365 days from the date of **IRB review and approval** unless otherwise stated in this letter. The regulations require that continuing review be conducted on or before the 1-year anniversary date of the IRB approval, even though the research activity may not begin until some time after the IRB has given approval. In addition, a waiver of individual authorization for use of Protected Health Information (PHI) was granted only for chart review by the Institutional Review Board as stipulated by the HIPAA Privacy Rule, 45 CFR 164 section 512(l).

The Institutional Review Board determined that the proposed research satisfies following criteria:

1. The use or disclosure of PHI involves no more than minimal risk.
2. Granting of waiver will not adversely affect privacy rights and welfare of the individuals whose records will be used.
3. The project could not practicably be conducted without a waiver.
4. The project could not practicably be conducted without use of PHI.
5. The privacy risks are reasonable relative to the anticipated benefits of research.
6. An adequate plan to protect identifiers from improper use and disclosure is included in the research proposal.
7. An adequate plan to destroy the identifiers at the earliest opportunity, or justification for retaining identifiers, is included in the research proposal.
8. The project plan includes written assurances that PHI will not be re-used or disclosed for other purposes.

The PHI for which use has been determined to be necessary by the IRB includes:

1. Fifty orthopedic inpatient records that will be randomly selected. These records will be retrieved from the Electronic Health Records/Clinical Patient Record System.

Date of IRB review and approval: 1/26/2006

On behalf of the Institutional Review Board,

A handwritten signature in black ink, appearing to read 'M. Caligiuri', with a horizontal line extending from the end.

/s/

Michael Caligiuri, Ph.D.
Director, Clinical Research Protections Program (CRESP)
(858) 455-5050

Note: All Human Subject research conducted at the VA facility and/or utilizing VA/VMRF funds MUST BE APPROVED by the VA Research and Development Committee prior to commencing any research. In addition, please ensure that the clinical trial agreement or other funding is appropriately in place prior to conducting any research activities. IRB approval does not constitute funding approval.

Approval release date: 3/17/2006

ERRATA LIST

Page	Original text	Text deleted	Corrections
9	An update on recent publications has been performed in the revision process of the dissertation in 2013.	- the revision process of the dissertation in 2013	An update on recent publications has been performed in 2013.
37	When revising this dissertation, new publications	- When revising this dissertation	When updating the literature in 2013, new publications
39	A publication from 2011 has been added to the literature view on this topic, exploring content overlap in handoffs between nurses and physicians.		

Sections, that are not numbered, have been removed from the list of content.

